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THE EFFECT OF NUTRITION ON THE COLOR OF THE CALLUS OF POLINICES DUPLICATUS

By HARRY J. TURNER, JR.[1]

Color patterns of the shells of mollusks are occasionally included in descriptions of a species. However the use of color patterns as a diagnostic specific character must be considered with caution because of the variability that may occur within a given species. As an example, the beach clam, *Donax variabilis,* displays a wide variety of colors and patterns. Similarly the carnivorous gastropod, *Purpura* (= *Thais*) *lapillus,* may be plain or banded depending on the diet (Moore, 1935). Specimens subsisting on a diet of *Mytilus* tend to have broad dark bands while those feeding on *Balanus* display either plain colors or only faint markings. A shift from a *Mytilus* to a *Balanus* diet alters the deposition of the darker pigments so that banding of the new shell is either faint or absent.

The predaceous moon snail, *Polinices duplicatus,* is distinguished from other members of the genus by the presence of a prominent callus that partially obscures the umbilicus. Say (1858) in his original description of the species reported the callus to be dark brown and this character has been repeated in various manuals of conchology (Minor, 1950, Abbott, 1955). Recently the author discovered a population of *P. duplicatus* at Duxbury, Massachusetts, in which a very high percentage of the specimens possessed calluses that were pearly white with faint pink margins at the lines of contact with the main bodies of the shells. A collection of 315 specimens taken from this locality contained 256 individuals with white calluses, fairly evenly divided between the two sexes. The live weights of the individual specimens of the collection ranged from one to 27 grams and the 59 snails with the brown callus were scattered at random throughout the range. In a similar collection taken from Barnstable Harbor,

[1]Contribution Number 938 from the Woods Hole Oceanographic Institution.

Massachusetts, 388 out of 479 specimens had the typical brown callus. The question arose as to whether the variation in color was due to some environmental influence or to a genetic difference. Serious consideration was given to placing the kind with the white callus in a separate subgenus.

The environments of the two localities were similar in many respects. Both were flats of fine compact sand near the low tide mark and there was little difference in temperature and salinity. The flat at Duxbury, however, was heavily populated with a recent set of soft clams, *Mya arenaria,* which the snails were consuming in large numbers while the Barnstable flat contained no *Mya* at all. The only significant food supply in the latter locality was a dense population of the tiny duck clam *Gemma gemma* which appeared to be utilized only by the smallest snails although an occasional specimen could be found feeding on a mud snail *Nassa* or a razor clam, *Ensis.*

The marked difference in the food supply in the two localities suggested that the color variation of the callus of *P. duplicatus* might be due to nutrition rather than a genetic difference. To test this possibility, five snails, each with a dark brown callus and weighing approximately one gram, were placed in a box of sand supplied with a continuous stream of salt water from the laboratory seawater system. One hundred soft clams, *Mya arenaria,* were added for food. As a control, five additional snails, each with a brown callus, were placed in a similar box of sand but no food was added.

The experiment was run for 35 days. The snails in the first box drilled and consumed 83 clams and gained a little over two grams in weight on the average. In every case the callus had turned pearly white with only the faintest tinge of pink at the margin. Each snail had secreted enough shell to advance the leading edge of the lower whorl slightly more than 180 degrees. The snails that had not been supplied with clams neither advanced the leading edges of their shells nor gained weight and the calluses remained dark brown.

It is clear that the large number of specimens of *P. duplicatus* with white calluses in the Duxbury population resulted from the abundant supply of *M. arenaria* as food. Similarly the preponderance of snails with brown calluses at Barnstable was due

to a scarcity of suitable food. Apparently also, the typical condition as described applies to specimens which are poorly nourished.

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TERATOGENY IN AUSTRALORBIS GLABRATUS[1]

By E. H. MICHELSON and ANN R. SCHORK
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Reports of monstrosities in snails refer primarily to malformed shells and to morphological anomalities produced experimentally in embryos (Raven and Beenakkers, 1955). The present observation is unusual in that it concerns teratism resulting from abnormal cleavage of the snail ovum. To our knowledge, it is the first such observation reported with reference to "normally reared" laboratory snails.

The anomaly with which we are concerned is the development of three conjoined snails from an individual egg (fig. 1). Fourteen additional eggs were found in the same mass, all of which developed into normal snails. The egg mass was obtained from a three-gallon rectangular aquarium which contained 25 adult *Australorbis glabratus.* Marble chips formed the substrate and approximately 60 grams of watercress, which was used as food, floated free in the water. The temperature of the water was thermostatically controlled at 25±2°C.

On microscopic examination of the abnormal egg, the three individuals within appeared to radiate from a common center. Each individual had an apparently normal foot and head region

[1] This investigation was supported (in part) by a research grant (E-513-C) from the National Institute of Allergy and Infectious Diseases, National Institutes of Health, Public Health Service.

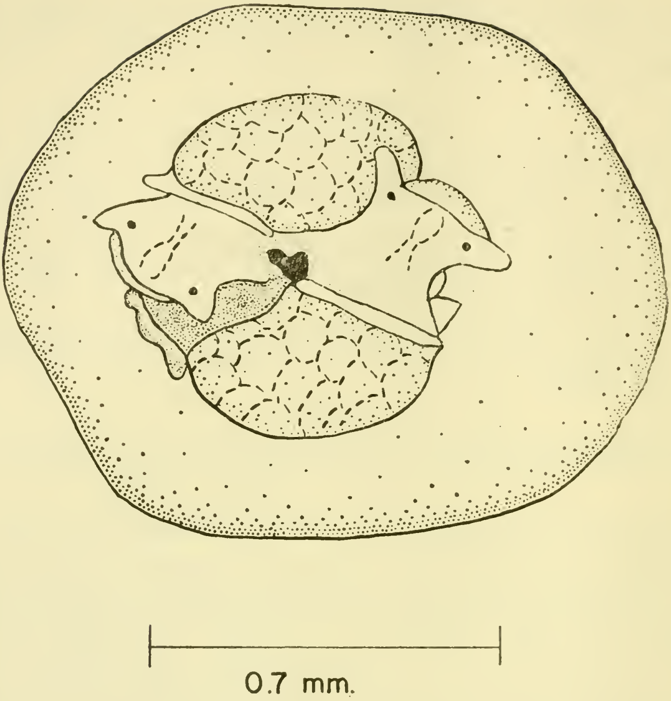

FIGURE 1: Camera lucida drawing *of Australorbis glabratus* egg containing three conjoined snails. Two of the snails are viewed dorsally while the ventral surface of the foot of the third snail appears as a stippled region between them. The solid black region indicates the position of the heart.

with tentacles, eyes and a mouth. At a higher magnification (60×) a radula could be observed in the mouth region of each snail. However, a single heart, consisting of an auricle and ventricle, served the three bodies. The pre-hatch ventricular heartbeat was 85.7 beats per minute which was slower than that observed in normal pre-hatched snails. On the third day of observation the "monster" hatched, and at this time a ventricular heartbeat of 75.0 beats per minute was recorded. Three days later the heartbeat had slowed to 46.1 beats per minute which was maintained until death occurred four days later. During the seven days the animal survived post-hatch, it was exceedingly active and continually crawled about its aquarium. When crawling, one individual would rest on the substratum carrying the other indi-

viduals above and gave the effect of a walking "Y." Carmine particles ingested by the various heads indicated that each animal had an independent alimentary canal.

The rarity of the preceding condition can be appreciated in that it was the only such abnormality we have observed in a microscopic examination of approximately 150,000 eggs during the past three years.

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THE LAND SNAIL GENUS MICROCONUS

By FRED G. THOMPSON

The genus *Microconus* Strebel & Pfeffer may be defined as follows: Stylommatophorous Pulmonata of the subfamily Thysanophorinae. Shell small, helicoid, 2 to 3.5 mm. wide. Lip simple, not reflected. Umbilicus moderate, at most only partly obscured by reflected columella. Peristome varying from horn yellow to umber. Growth wrinkles numerous, fine and irregular, crossed by finer spiral striae which bead them (the spirals can only be seen with proper lighting under magnification ×60). Suture deeply impressed.

Genitalia with spermatheca lying above aorta; with a vestigial flagellum retained within wall of vas epiphallus; prostatic end of vas enlarged, with thick muscular wall; ovotestis bilobed; talon with a long stalk; carrefour exposed.

Jaw solid, with 5 to 7 broad ribs. Radular marginals relatively broad and with entocones. Digestive system as usual in Thysanophorinae. Salivary glands quite small, flattened, subcircular, touching above oesophagus and joined by isthmus below so as to form a complete, elongate or circular collar.

Lung (pl. 2, fig. A) a little more than twice as long as broad, and 2 or 3 times length of kidney. Heart relatively large. Principal lung vein without evident tributaries. Kidney triangular, longer than broad. Sigmurethrous ureter complete.

Tentacles black. Sole elongate, with parallel sides and rounded ends, crossed by about 20 dark folds and lighter sides. Tail with medio-dorsal groove.

In the Thysanophorinae, four genera are known anatomically: *Mcleania, Microconus, Microphysula* and *Thysanophora* (Baker, 1940). The structure of the penis, the vas epiphallus, and the shell relate *Microconus* more closely to *Thysanophora* than to

Map 1, Distribution of *Microconus*
(N.B. Triangle is for *M. pilsbryi.*)

the other genera. However, *Microconus* differs from *Thysanophora* in 4 distinct ways: (1) the spermathecal sac lies above the aorta; (2) a vestigial flagellum is present; (3) the radular marginals have entocones (only ectocones in *Thysanophora*); and (4) the shell lacks protractive (more oblique) periostracal riblets (present in *Thysanophora*) but has fine, spiral striae.

Distribution: Microconus has been recorded from middle America, from the Canal Zone to central Veracruz, Mexico. All the 4 known species have been found in only limited regions (Map 1).

Dissections of *M. pilsbryi* were made under a dissecting microscope. The animals had been partially relaxed in the field with sodium nembutal; after fixation in formalin, they were preserved in 70% alcohol. Prior to dissection, the shells were dissolved in a 1% solution of HCl. The animals were then stained with borax-carmine. All drawings were made with aid of a camera lucida. Ridgeway was used for a color guide.

This work was done with the sponsorship and guidance of Dr. Henry van der Schalie. Dr. H. A. Pilsbry kindly loaned me the only specimen of M. *wilhelmi* in the Philadelphia Academy collections. Paul F. Basch made available to me his material of *M. rufus*.

The 4 species known to belong to *Microconus* are: *M. wilhelmi* (Pfeiffer), *M. rufus, M. pilsbryi,* and *M. termitarum* Pilsbry. Only *M. wilhelmi* and *M. pilsbryi* are known anatomically, but seem to represent two subgenera, one of which is described as new.

MICROCONUS Strebel & Pfeffer, type *Helix wilhelmi* Pfeiffer.

The typical subgenus is distinguished by its small spermatheca, its penial retractor attached to the diaphragm, and its vas deferens free from the side of the penis. The jaw has five ribs. The adult shell has a higher spire, but a larger umbilicus, which is 1/3 to ¼ the shell diameter.

MICROCONUS WILHELMI (Pfeiffer).

Helix wilhelmi Pfr., 1866, pp. 79-80. *M. wilhelmi* Strebel & Pfeffer, 1880, pp. 29-30, pl. 4, fig. 7. Pilsbry, 1926, p. 80, fig. 12b. H. B. Baker, 1927, pp. 236-238, pl. 18, figs. 31-40 (anatomy).

Type locality: Mirador, Veracruz, Mexico. Also known from Necaxa, Veracruz.

MICROCONUS RUFUS, new species. Pl. 1, figs. A, B

Thysanophora conspurcatella (Morelet) Goodrich & van der Schalie, 1937, p. 26.

Holotype: shell umbilicate, umbilicus about ¼ shell diameter. Shell turbiniform, nearly as high as wide, with obtuse apex and 4¾ whorls. Suture deeply impressed. Whorls strongly convex, shouldered; the last not descending. Embryonic whorls 1½, smooth, protruding, horn yellow; remaining whorls horn yellow, with minute, but distinct, unequal, unevenly spaced, microscopic growth-wrinkles, which are cut by weakly incised, spiral lines. Aperture irregularly ovate, incised by penult whorl; columellar margin slightly reflected, but not obscuring umbilicus; peristome thin, glassy, and transparent. Height 2.8; diameter 3.5: width of umbilicus 1.0 mm.

Dept. Petén, Guatemala. Holotype: University Mich. Museum of Zoölogy (UMMZ.) 64416; knoll along Santa Ana Road, 2 km. south of Puebla Nueva (Henry van der Schalie! Feb. 15, 1935). Paratypes: UMMZ. 193099; same data; UMMZ. 193285-193314 (124 examples) from vicinity of Tikal (Paul F. Basch! Feb. 4 to May 16, 1956). Also examined: UMMZ. 64417, west shore of Lake Petenxil; UMMZ. 64418, limestone knoll east of road to Santa Ana, about 1¼ miles south of Flores; UMMZ. 64419, limestone outcrop 1 mile northwest of Paso Caballo; UMMZ. 64420, limestone knoll, 5 miles north of Paso Caballo; UMMZ.

64421, north shore of Lake Yaluk, about 6 miles east of Paso Caballo; UMMZ. 64422, limestone outcrop, 6 miles south of Laguna Perdida.

M. rufus was abundant in jungle regions subjected to periodic rainy (usually June to August) and dry seasons. Since the collections were made during the dry season preceding the rains, only dead shells were found in samples of leaf mold and in debris along rivers.

Young individuals are relatively more depressed and have thinner shells, which makes the spiral striae more easily observed. *M. rufus* differs from *M. wilhelmi,* the other species of the typical subgenus, because the whorls of the former are more strongly convex, proportionately slightly larger and not so strongly shouldered, and have finer and closer growth-wrinkles. Also the embryonic whorls of *M. rufus* do not protrude so much, the body whorl lies further under the penultimate one; and the umbilicus is smaller.

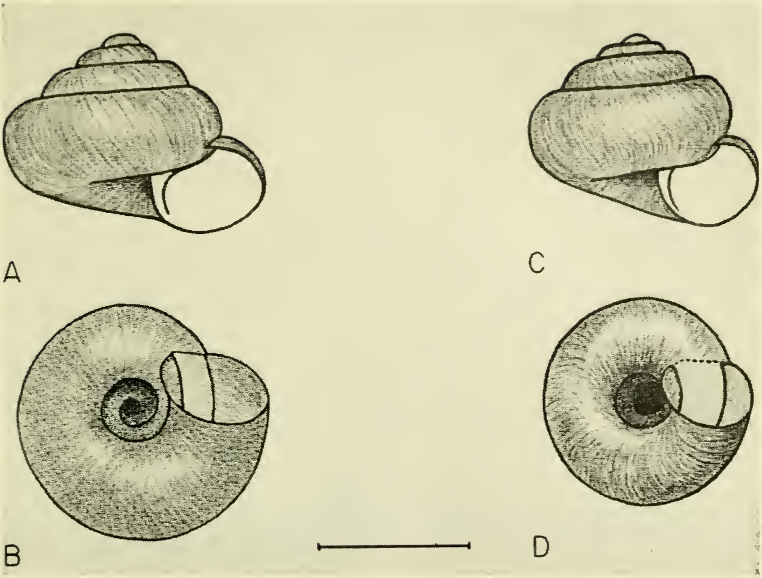
PULCHRICONUS, **new subgenus.** Type *M. pilsbryi,* n. sp.

This subgenus is characterized by a large spermatheca, and the absence of a penial retractor; the epiphallic end of the vas deferens is attached to the side of the penis by narrow bands of muscle fibers. The adult shell is ovate-globose, and the jaw has 7, broad ribs.

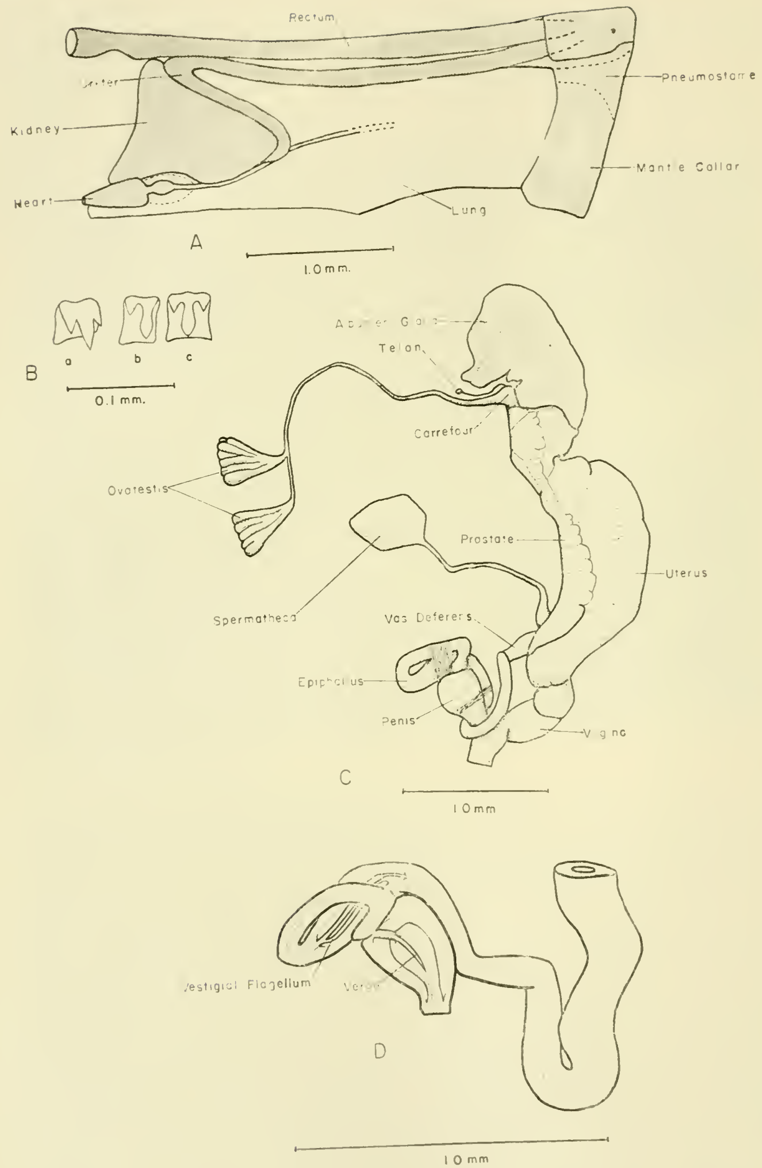
MICROCONUS PILSBRYI, **new species.** Pl. 1, figs. C, D; pl. 2, figs. A-D

Holotype: (pl. 1, figs. C and D) shell umbilicate, umbilicus about 1/4 shell diameter; shell slightly wider than high, with obtuse apex and 4 1/2 whorls. Embryonic whorls 1 1/2, horn yellow, and showing under magnification (×60) a reticulate pattern of fine granules, which reflect a slight iridescence. Remaining whorls clay color, dull, but with tendency to become burnt umber in color near suture and umbilicus; strongly convex and strongly shouldered; and minutely, but distinctly roughened by unequal, close, microscopic growth-wrinkles, cut by weakly incised, spiral lines. Suture deeply impressed. Last whorl descending towards aperture, which is broadly oval, somewhat incised by preceding whorl, and with columellar margin slightly reflected over umbilicus; peristome thin, but distinctly expanded, glassy and transparent. Height 2.2; diameter 2.5; width of umbilicus 0.6 mm.

Holotype: UMMZ. 193100; 4 1/2 km. south of Matagalpa, Dept. Matagalpa, Nicaragua, 3,500 feet altitude (Thompson! July 16, 1956). Paratypes: UMMZ. 193101 (104 specimens); same data.



Figs. A and B. *Microconus rufus* Thompson, holotype shell. Figs. C and D, *M. pilsbryi* Thompson, holotype shell.



Microconus pilsbryi Thompson: Fig. A, internal view of lung and associated organs. Fig. B, radular teeth: a, marginal; b, lateral; c, central. Fig. C, male and female genital system. Fig. D, enlarged penis, epiphallus, and vas deferens, showing internal structures.

M. pilsbryi was found abundantly in coffee groves, well shaded by a thick canopy of large trees, under the bark of rotting logs. Moisture was plentiful; in the mountain rain forest, the daily rainfall during 10 months of the year provided an abundance, and moderate amounts occurred in the other 2 months.

Young shells are more depressed than the adults, and the spiral striae are more apparent, because of the thinness of the shells. *M. pilsbryi* has a larger umbilicus and more strongly shouldered whorls than *M. termitarum,* which also is included tentatively in the subgenus *Pulchriconus.*

Genitalia (pl. 2, figs. C and D) : Ovotestis bilobed; each lobe with 5-7 claviform lobules; hermaphroditic duct straight and enlarged basally. Carrefour small, exposed; talon very small, ovoid, compressed and with very long stalk. Albumen gland elongate and compressed. Prostate with about 20 equal convolutions, which are not distinct because partially imbedded in uterus. Spermatheca subpentagonal, imbedded at base of pericardial side of albumen gland, with duct relatively long, columellar in position, and enlarged at base. Cloaca short and stout; opening just below and behind right ommatophore. Free vas deferens very large, especially near prostate, with thick muscular wall; passes between penis and vagina, encircles base of former, and continues up penial side to epiphallus; held in place by a muscular band that encircles it and middle of penis. Vas "epiphallus" developed in terminal loop and held to penial apex by another muscular band, which encircles both and is connected to the vas band by a slender ribbon of muscle fibers;[1] epiphallic lumen smaller than that of vas for ¼ the length of the 1st (vas) limb chamber, beyond which it continues as a duct that gives rise to an included blind pouch,[2] expanded in 2nd (penial) limb into a bulbous chamber, and narrowed again to enter penis through a terminally bifurcate, vergic papilla, in a bulbous sheath within penial lumen. Penis short and very stout, cylindric.

Radula (pl. 2, fig. B) very similar to that of *M. wilhelmi,* but mesocone of first lateral more lanceolate. Entocone developing on 7th lateral and persisting through marginals, as Baker (1927) found.

MICROCONUS (PULCHRICONUS?) TERMITARUM Pilsbry.

M. termitarum Pilsbry, 1926, pp. 80-81, fig. 12a. Type and only

1 These bands and ribbon may represent modifications of the penial retractor, but the latter is considered non-existent in *M. Pilsbryi* since they could not function as such.

2 Apparently equivalent to "vestigial flagellum" (Baker, 1927) in *M. wilhelmi.*

known locality: Barro Colorado Island, Canal Zone, Panama (ANSP. 140824).

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SPHAERIUM NITIDUM AND S. PATELLA

BY H. B. HERRINGTON

SPHAERIUM NITIDUM Clessin vs. *S. tenue* Prime.

Apparently, according to the judgment of Dr. Horace B. Baker, "*Cyclas tenuis* Prime, 1852, is the only valid publication and later ones do not affect its problem." Others agreed with this in principle.

Because Prime's small creek specimens of *C. tenuis* from New Bedford, Mass., of 1852, which may have had some slight resemblance to *Sphaerium occidentale* Prime, 1860, appear to have been given by him to the Boston Society of Natural History, and cannot be located now, *C tenuis,* 1852, is completely unidentifiable.

In 1853, Prime added to this locality and placed specimens from the Androscoggin River, Maine, under the same name; again in 1865 he used *Sphaerium tenue* (Prime) for these Androscoggin shells. In 1865, he dropped New Bedford from his "Hab."

Since he lists *S. tenue* (Prime) as "5" under *S. occidentale* Prime, 1860, when he catalogued his specimens before giving his collection to the Museum of Comparative Zoölogy, Cambridge, Mass., in 1895, the shell in the Museum of Comparative Zoölogy, no. 19474, which also came from the Androscoggin River, and which is labeled *Sphaerium tenue* Prime, 1865, not 1852, must be considered a misidentification. This specimen is a local form of *S. nitidum* Clessin, 1876, which would not occur at New Bedford, Mass. For these reasons, *Sphaerium nitidum* Clessin, 1876,

must be used instead of *S. tenue* (Prime), 1865.

SPHAERIUM PATELLA (Gould) vs. *S. primeanum* Clessin.

An examination of specimens of *S. primeanum* Clessin, 1878, from several museums and of 3 sets of *S. patella* (Gould), 1850, from the Museum of Comparative Zoölogy, has revealed that the shells of *S. patella* are immature, somewhat weathered specimens of what was later described, by Clessin, as *S. primeanum.* Although the *patella* shells do lack the usual bluish nacre of *primeanum,* this is the result of immaturity, weathering or a different kind of habitat, or a combination of two or more of these factors.

The color of the nacre of *S. primeanum* varies greatly. I find that the darker the periostracum and the more encrusted with foreign matter, the darker is the shade of the nacre. Some specimens that are not encrusted and have a lighter shade of periostracum also have only a pale blue nacre. [I also have found this to be the case with *S. fabale* (Prime). And, I have seen *S. striatinum* (Lamarck) with a deep blue nacre.] I have one shell with the pale *patella* nacre, received from W. J. Eyerdam, which has the usual *primeanum* size.

FEEDING HABITS OF TWO SPECIES OF ODOSTOMIA

By J. FRANCES ALLEN
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Fretter and Graham (1949) when describing the structure of the Pyramidellidae state that they are ectoparasites, each species feeding on a particular host, usually a tubiculous worm or a lamellibranch mollusk, obtaining attachment to the body by means of an oral sucker, piercing the body wall with the buccal stylet, and sucking blood and perhaps tissue debris by means of the buccal pump. Six species of this family are listed with their respective hosts, one having two hosts. The same authors state, "They will be found to feed on no other animal." Marshall (1900) notes the presence of *Turbonilla rufescens* on the leathery tube of a sessile annelid and *Odostomia albella* with littorinas. Gardiner (1934) mentions the occurrence of *O. perezi* with *Phascalion strombi.* Cole (1951) describes the effects of *O. eulimoides* on oysters (*Ostrea edulis*) and Cole and Hancock (1955)

are of the opinion that the Pyramidellidae may be less host specific than has been suggested previously, and discuss the feeding of *Odostomia scalaris* on *Mytilus edulis* and, for the first time, report *Chrysallida obtusa* on oysters. *O. seminuda* has been observed by Robertson (1957) to feed on *Crepidula fornicata*. Loosanoff (1956) states that *O. bisuturalis* is found in large numbers on small oysters (*Crassostrea virginica*) in New England waters and Hopkins (1956) points out that *O. impressa* attaches itself to large oysters. Allen (1954) reported finding *O. bisuturalis* in the Little Annemessex River of Chesapeake Bay thus extending its distributional record south of Delaware Bay (Abbott, 1954). Their presence in an area well removed from oyster bars and other hard bottom indicates that this species is not specific for oysters and the occurrence of *O. impressa* under similar conditions indicates the same could be true for it.

Berry (1954), says that the morphology and ecology of the North Atlantic species indicates that the Pyramidellidae are obligatory ecto-parasites possessing strong opisthobranch tendencies and that the close host-parasite specificity indicated with other mollusks, annelids, coelenterates "affords the first reasonable explanation of the existence of so many often closely related sympatric species and opens a wide untilled field to the student of parasitism. . . ."

The author wishes to express her appreciation to the General Research Board of the University of Maryland for the grant which made this study possible and to Mr. Joseph A. Marshall and Mr. Kent S. Price for their assistance.

Methods: Odostomia impressa, apparently the most abundant pyramidellid in the area, and *O. bisuturalis,* as a second form, were selected for the investigation to determine whether or not either species is host specific. Oysters; wigeon grass, *Ruppia maritima;* mud and general bottom materials were collected by means of an oyster dredge from the Maryland waters of Chesapeake Bay, including Pocomoke and Tangier Sounds, the Little and Big Annemessex Rivers, and the Manokin River. The oysters and the empty shells were examined macroscopically and microscopically both on the outside and the inside, and the grass, mud, and debris were washed through U. S. Standard sieves and the

two species, when found, were isolated.

Each species was given the opportunity of feeding on various potential hosts, including oysters; *Crepidula convexa; Bittium varium,* Pfr. and several other gastropods; polychaete worms, and the tunicate, *Molgula.* Observations were also noted on the length of feeding time.

Some of the oysters were stained with neutral red which was found to be satisfactory for our purpose and which has been successfully used on oyster larvae (Loosanoff and Davis, 1947). The oysters were submerged into plastic vessels containing aerated bay water to which the solution of dye was added. After several days, the oysters were rinsed by several changes of water to prevent any color being in the water. The left valve was removed from each oyster and a number of *O. impressa* placed on the oyster and at the margin of the valve, in the vicinity of the mantle. To assure that any color taken up by the pyrams must come as a result of feeding and not from any undetectable color in the water, specimens were placed in a vial covered with a 3″ U. S. Standard sieve No. 200 so that the water could circulate freely about them. The set-up was left undisturbed for 24 hours. The snails were then removed from the vial and from the oysters and examined with a binocular microscope.

Observations and Discussion: Both *O. impressa* and *O. bisuturalis* were observed in small characteristic pockets along the margin of the shell, and also were distributed in general on the outside of the shell. They were often found at the mouth of the tubes of the tubiculous worms which adhere to the shell. The laminated condition of the shell as described by Cole and Hancock (1955) was observed here. After removing one valve, groups of the snails up to 12 in number were found concentrated in the vicinity of the mantle, in one group, with a total of 17 associated with a single oyster. Cole and Hancock (1955) report finding up to seven specimens of *O. eulimoides* in one dying oyster. No damage to the adductor muscle was found as described by Cole (1951) and Cole and Hancock (1955). However, the ridged condition of the shell as described by these same authors did occur.

O. impressa attached itself to *Bittium varium* with great vigor. The prey gave the characterictic 'jerk' as described by Fretter

and Graham (1949) when describing the feeding technique of *Odostomia* on worms. When other organisms were placed in the same container, *Bittium* was usually selected as the chosen food. If disturbed so the *O. impressa* ceased feeding it would start over again when the disturbance was removed. It was possible to hold *Bittium* with forceps and move it about while *impressa* was feeding without causing it to withdraw the proboscis.

O. scalaris has been observed to protrude its proboscis into the siphonal canal of *Mytilus edulis* and remain in that position for several days (Cole and Hancock, 1955). Robertson (1957) notes that *O. seminuda* would attach to the mantle of *C. fornicata* for several seconds at a time. *O. impressa* fed on the oyster for long periods and on *Bittium* for more than two hours. It is not difficult to see the action of the buccal pump and the actual feeding when observations are made with a binocular microscope.

O. impressa, in addition to the oyster and *Bittium* fed readily on *Crepidula convexa; Triphora nigrocincta;* the oyster drill, *Urosalpinx cinerea;* a polychaete worm; at the incurrent siphon of the tunicate, *Molgula;* and on another species of pyram, probably *O. gibbosa*. It was noted that this species would not feed on *T. nigrocincta* if any one of the other forms mentioned was available.

When the snails were removed from the stained oysters, they had become pink in color. Since the pyrams are white except for the black eyes and the shells more or less transparent, the pink color was readily observed. When they protruded from the shells, the animals themselves were definitely pink. Since the specimens which had been placed in the vial, as a control, showed no pink color, obviously the neutral red had been taken up with the body fluids of the oyster during feeding.

Although *O. bisuturalis* occurred on the oyster shell and along the margin of the shell, this species was not observed to feed on the oyster meat nor on any other potential prey mentioned. They were abundant on the shells and in the washings from the grass. When placed adjacent to *B. varium* they never made any attempt to pierce the animal but they would crawl onto the shell. When this was noted *bisuturalis* was placed with specimens of *Bittium* which were dark green from the plant material on their shells. After moving onto the *Bittium* shell the pyram

would protrude its proboscis and the body would move continually in a circular pattern. While being closely watched, it was observed that the algae was cleaned from the shell leaving a small round spot. Occasionally, when the pyram moved in a forward direction, a clear white area would appear. Additional observations are necessary to clearly define the feeding habits of *O. bisuturalis.*

Summary

This investigation has shown that *Odostomia impressa* is not host specific for oysters and the feeding habits of *Odostomia bisuturalis* are not clearly defined. The evidence reported here and that which has been contributed by workers in the field and cited indicates that the Pyramidellidae do not appear to be a family of host specific ectoparasites.

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HELIX POMATIA COLONY AT JACKSON, MICHIGAN

By HENRY VAN DER SCHALIE AND DEE S. DUNDEE

On September 13, 1957, *Helix pomatia* was again collected in the region of Union Street in Jackson, Michigan. This colony was originally reported 20 years ago by A. F. Archer (Nautilus, 51: 61-65, 1937). The snails were then common in the garden of an Italian family by the name of Maddalena, where, five years previously, they had been introduced as a food. The neighbors complained about the introduction and claimed that the snails were damaging their gardens. However, Archer stated that he thought the animals were harmless. At that time Meisenheimer (1912: 119) had published the following statement (as translated into English): "The existence of many plants might well be at stake if they are not protected against being eaten by the snails through the above mentioned media (hairs, acrid juices, etc.). Particularly endangered are those plants which contain sweet tasting materials to which the snails are particularly disposed, and certainly cultivated plants of this kind might well be placed under the special care of humans."

More recently, Fromming (1954: 283, table 6) indicated that *H. pomatia* eats a wide variety of vegetables. In a summary way, he (1954: 360-61) stated: "From the information given above it follows without any doubt that these snails must be considered most dangerous in cultivated regions since a simple estimation shows what great damage a couple of thousand of these animals can inflict in a short time."

A number of changes have occurred in this colony in the 20 years since Archer's account was written. The block into which they were originally placed has become much more urban; houses with lawns surrounding them now fill the entire block. The back yards are now far more open and there is less cover for the snails than formerly. At the time of the first report, some of us tacitly assumed that the snails would probably not cross the macadam pavements of the streets and might thus remain confined to the block where they were originally placed. Unfortunately, this assumption has proven quite erroneous because these snails now occupy several blocks east and west of their original site and they were reliably reported to have gone a long

distance to the south. That the colony had spread and was maintaining itself was evident from the fact that on many occasions William G. Fargo gathered specimens which he supplied to us for class work. A neighbor informed us that the snails had become established in the Fargo garden.

During our recent collecting trip *H. pomatia* were obtained along the back border of one yard at 1015 Third Street where a good cover of grass and vines ran along the fence margin. Some adults and many young were taken. Dee Dundee collected a good series of snails of all ages in this same region three years ago. In a neighboring yard to the north (1009 Third Street), the Rev. Emil A. Runkel kindly took us to the small garden in his back yard where we learned that the snails were very destructive to his produce. He explained that unless he used pellets of a molluscocide called "Bug-Geta", he could not have a garden. The metaldehyde (produced and distributed by a firm in California) proved to be a reasonably good eradicator, but we did find a few snails in that garden. Rev. Runkel stated that he had seen snails moving over his lawn and into his garden from an adjoining yard during and after rains. Damage was inflicted by the snails on tomatoes, lettuce, cabbage and strawberries. Radishes were eaten avidly and proved impossible to grow at all. On the other hand, carrots were reported unharmed. Another neighbor found that flowers in her garden were often damaged. The people in the community agreed that uncultivated yards evidently provided the kind of ground cover in which the colony could thrive and maintain itself.

The history of this colony in Jackson clearly indicates that more rigid control is necessary to avoid such introductions. Possibly concerted effort may yet enable the eradication of this colony. It is gradually spreading and these animals may in time be a source of serious damage to truck and vegetable crops. The history of *Helix aspersa* O. F. Müller in California is an example of what should be avoided in Michigan. Often those who introduce the animals are unaware of the seriousness of the problems they may inflict on a community. Several years ago a physician, who was intrigued by the prospects of having such large and handsome snails on his farm, called by telephone to inquire whether he should introduce them there. The information given

him probably discouraged him from carrying out that idea, but one wonders how many similar plans may have succeeded without anyone to dissuade the introducer.

Problems of eradication are difficult and often costly in the time consumed and materials needed. One always hopes to find some biological method of control. Unfortunately, the number of predators listed for *Helix pomatia* are few. Fromming (1954: 364) listed starlings, ravens, magpies; frogs, toads; moles; in unusual situations, leeches; and the slug, *Arion empiricorum* Fer. is reported to have a predilection for the young *H. pomatia*. Wild and Lawson (1937: 355) in their study of enemies of the land and freshwater mollusks in the British Isles mention the shrew, bank vole, common vole, reed warbler, wheatear, Kentish plover, common snipe, jack snipe, herring gull, land rail, water-rail and a beetle, *Silpha*. These several enemies are animals common to the European continent. The predators that are most effective in the Jackson area are, as yet, undetermined. As to sources of information dealing with molluscocidal control, W. H. White and A. C. Davis (1942:8) in a bulletin entitled "Land slugs and snails and their control" have a section devoted to poison baits in which they suggest that arsenicals and metaldehyde are effective. The summary of an earlier paper by A. L. Lovett and A. B. Black (1920) stated that: "Bordeaux mixture, either liquid or dry, is an excellent repellent. Calcium arsenate prepared as a bait is readily devoured and is highly toxic to slugs. A combination of a repellent and a poison bait constitutes the most effective control procedure."

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NEW RECORDS OF WEST INDIAN STREPTAXIDAE

By WILLIAM J. CLENCH

Two species of streptaxids, *S. glaber Pfeiffer* and *S. deplanchei* Drouët have been collected recently in St. Thomas and St. Martin.

Mr. G. A. Seaman collected *S. glaber* Pfeiffer on St. Thomas, Virgin Islands, and *S. deplanchei* Drouët on the Island of St. Martin in the northern portion of the Lesser Antilles. Both of these species were introduced into these islands probably on plants or other imported material from northern South America in rather recent times.

Of the two species, *S. glaber* is the more abundant and probably reached as far north as Barbados in pre-Columbian times. *S deplanchei* is a rare species, to judge by our collections, and has not been reported heretofore in the West Indies.

Diaphora bicolor Hutton, an emigrant from Asia, has been recorded from several localities in the West Indies. It was introduced, possibly, first into Trinidad from India and has since spread to many islands in the West Indies. I append such localities as I believe may be new for the record.

STREPTAXIS (STREPTARTEMON) GLABER Pfeiffer.

Streptaxis glabra Pfeiffer 1849 [1850], Proc. Zool. Soc. London, p. 126 (Demerara [British Guiana]); Pfeiffer 1850. Conchylien-Cabinet (2), 1, pt. 12, sec. 2, p. 21, pl. 124, fig. 4-7 (Demerara).

Specimens examined: Paramaribo, Dutch Guiana. Kartabo, British Guiana. Machango, Distr. Bolivar, State of Zulia, Venezuela. Itacoatiara; Caruoeiro, Rio Negro; Manaos and Santa Maria, Lower Rio Negro, all Amazonas, all Brasil. Usine, Ste. Madeline, San Fernando, Trinidad. Blowers, Barbados. St. Thomas, Virgin Islands.

STREPTAXIS (STREPTARTEMON) DEPLANCHEI Drouët.

Streptaxis deplanchei Drouët 1859, Mem. Soc. Acad. Aube, *23*, p. 352, pl. 1, fig. 6-9 (Ile la Mere, 3 miles off Cayenne I., French Guiana).

Specimens examined: St. Martin, Lesser Antilles. Cayenne [French Guiana]. Ceará Mirim, Rio Grande do Norte, Brasil.

DIAPHORA BICOLOR (Hutton).

Pupa bicolor Hutton, J. 1834, Jour. Asiatic Soc. Bengal *3*, p. 93 (Mirzapur, India).

Specimens examined: Cárdenas, Matanzas, Cuba. El Purio, Calabazar de Sagua, Las Villas, Cuba. Isle of Pines. Bethlehern; Rust-op-Twist and Concordia, St. Croix, Virgin Ids. Puerto Sosúa, Santo Domingo, Hispaniola.

NEW LAND SNAIL FROM QUEENSLAND

By ALAN SOLEM
Chicago Natural History Museum

In the process of examining Pacific Ocean land snails at the University of Michigan Museum of Zoölogy, several specimens labeled with manuscript names of John Brazier were discovered. Some have been subsequently described by other people, but I have been unable to locate any reference to the shell labeled "*Endodonta creon* Brazier" which is described below. This species sheds important light on the affinities of the genus *Theskelomensor,* and description of the single available specimen as a distinct species seems worthwhile.

THESKELOMENSOR CREON, new species. Pl. 3, figs. 1-3

A species of *Theskelomensor* with a moderately wide umbilicus, loosely coiled whorls, and the periphery with a cord-like keel. Shell small, thin, depressed-trochoidal, periphery of body whorl with a thread-like keel. Whorls 5⅞, slightly rounded, sutures little impressed. Spire only slightly elevated, base of shell inflated. Apical whorls 1½, smooth. Remaining whorls with sculpture of close-set, wavy, spiral lines partially interrupted by weak, slightly retractive growth striae. Aperture subtriangular, lip thin and not reflected. Parietal callus thin, white. Umbilicus open deep, contained 3.35 times in the diameter. Epidermal color translucent horn, underlying calcareous layer white. Diameter 6.7 mm., height 2.6 mm.

Holotype, University of Michigan Museum of Zoölogy 136666 from 20 miles northwest of Cardwell, Queensland, Australia.

Comparisons: The only Australian species related to this novelty is *Theskelomensor lizardensis* (Pfeiffer). The sculpture, shape, coloration, type of whorl increment, and apertures are similar, but the two species are easily separated (see figs. 1-6). *T. lizardensis* (figs. 4-6) has a supraperipheral keel, more whorls, and a wider umbilicus than does *T. creon.*

Outside of Australia, the most similar shells are found in Philippine Island — New Guinea *Inozonites — Pareuplecta —*

Zagmena complex. The Philippine species *I. bicarinata* Semper, *I. biangulata* Pfeiffer, *I. boholensis* Pfeiffer, and *I. reyesi* Hidalgo have the 2-keeled sculpture and shape of *T. lizardensis*. Other Philippine species (such as *P. subterranea* Quadras and Moellendorff) and the New Guinea *"Zagmena"* (such as *pratti* Gude and *haematina* Moellendorff) have the single keel of *T. creon*. All the above species differ from *Theskelomensor* in having the umbilicus barely perforate and the radial sculpture more prominent than the spiral sculpture. In the Ceylonese *Euplecta*, however, there occurs the same deep umbilicus and prominent spiral sculpture found in *Theskelomensor*.

The taxonomic position of *Helix lizardensis* Pfeiffer has long been uncertain, and Iredale's proposal of *Theskelomensor* only served to emphasize its uncertain position. The thread-like keel, smooth apical whorl and kind of microsculpture remove it from the Endodontidae, just as the thread-like double keels make it improbable that *T. lizardensis* belongs to the Trochomorphinae. The discovery of a second Australian species with only a single keel ties the shell into the helicarionid *"Euplecta"* series. The anatomy of these species is imperfectly known, and placement in one of the subfamilies of the Helicarionidae (= Ariophantidae) is not yet possible. The exact relationships of *Inozonites, Euplecta, Pareuplecta, Theskelomensor,* and *Zagmena* remain to be determined. *Euplecta* and *Theskelomensor* seem to be "good" genera, but the Philippine-New Guinea species placed in *Pareuplecta, Inozonites,* and *Zagmena* show no conchological differences which seem indicative of generic separation.

Zoögeographical comments: Southeast Asia and Indonesia represent a center of evolution from which successive waves of organisms have populated the other parts of the Indo-Pacific area. Relict distributions around the fringes of Indonesia are well known in many groups of animals and would be expected to occur in land snails. Unfortunately studies of the land snails in the past fifty years have tended to be faunistic surveys rather than systematic monographs. As a result cases of relict distributions are buried under an avalanche of generic and family names proposed for species of one area without regard for any extralimital relatives. Much more important than faunistic surveys, are systematic reviews of genera and families which will enable

us to determine the basic distribution patterns and study the possible origins of the faunas of individual areas.

Theskelomensor, if proved to be a helicarionid related to the *Euplecta* series, becomes an Asian element in the fauna of Queensland. As an endodontid, it becomes another endemic Australian taxon. Since the structure of *T. creon* provides some evidence that *Theskelomensor* belongs definitely to the Helicarionidae, it has been thought worthwhile to describe the species, even though only one shell is available. Only through such small additions to our knowledge will an eventual picture of Pacific land snail distribution emerge.

LIFE HISTORY STUDIES OF CAMPELOMA DECISUM

By NORMAN A. CHAMBERLAIN[1]

Only a few studies pertaining to the life history of the genus *Campeloma* (family Viviparidae, order Prosobranchiata) have been published. The genus is restricted to lakes and streams of eastern North America (Baker, '28) including some lakes and streams of piedmont North Carolina (Walter, '54). For these reasons the snail *Campeloma decisum* was chosen for a study of some aspects of its life history.

The first account of the morphology of the reproductive system in *Campeloma* (Call, 1888) was confined to the gross anatomy of male and female *C. subsolidum.* A more complete study of the morphology of the female reproductive tract in *C. rufum* was made by Mattox ('38). Crabb ('29) published an observation of young *C. decisum* being released in the laboratory. Young snails in the uterus (*i.e.,* gestatory sac) of *C. rufum* were described by Mattox ('35) as being enclosed in an egg membrane with no connection to the adult uterine wall.

Parthenogenesis was demonstrated in *C. rufum* by Mattox ('37) in a study based on histological examination. An abortive second maturation division was shown which left the ovum with the somatic number of chromosomes:—12. Pollister and Pollister ('40) reported the results of a number of studies they had made on somatic chromosome numbers in ten species of the family Viviparidae. They found in four species of *Campeloma* and in

[1]Honors research in zoology at the University of North Carolina under direction of Dr. C. E. Jenner.

six other species a variation of 24 to 28 chromosomes in somatic cells. They reasoned that if Mattox's count (12) was correct, then there were two possibilities: either *C. rufum* is a parthenogenetic haploid animal and the ten other viviparids studied are diploid; or *C. rufum* is a parthenogenetic diploid animal and the ten other viviparids studied are tetraploid. They concluded that the latter is the more likely.

Medcof ('40) published a study on aspects of the life history of *Campeloma* (cf. *C. decisum*) in Ontario.

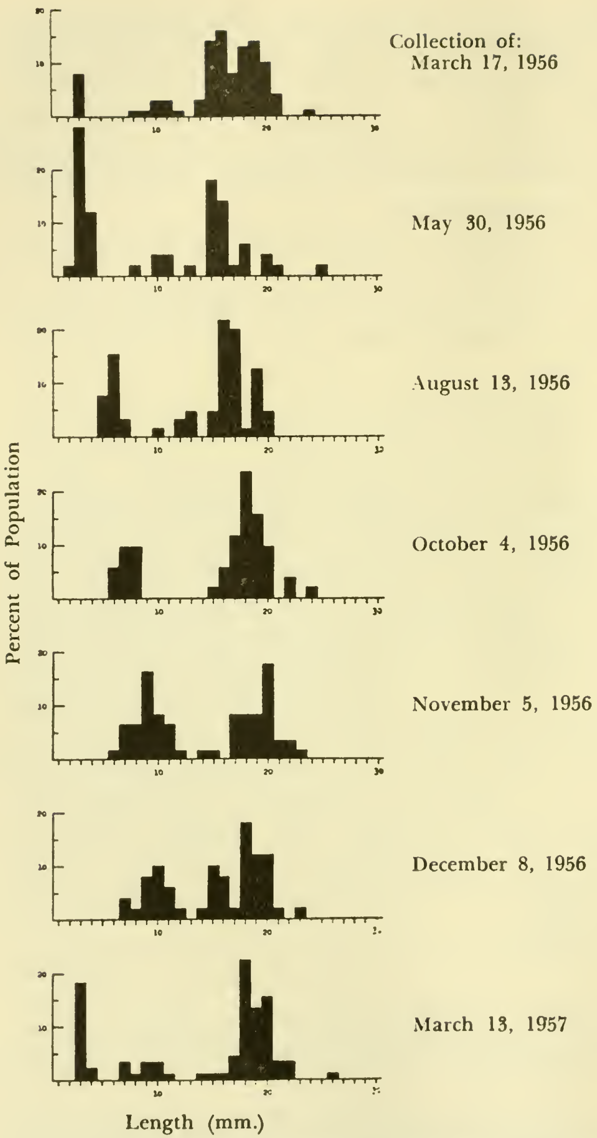
This study was limited to aspects of the life history of *C. decisum* including population analysis, growth, feeding, reproduction, and parasitism.

Materials and Methods: Snails were collected from University Lake, 3.5 miles S.W. of Chapel Hill, North Carolina. The snails (pl. 3, fig. 7) were named as *Campeloma decisum* (Say) by Dr. William Clench of the Museum of Comparative Zoology at Harvard College, and a collection was placed in that museum (MCZ. No. 212378). All collections were taken from an area covering about 50 yards along the east shore and extending out about 10 yards into the lake. The material was collected with a hand dredge consisting of a wire basket with mesh 1.5 by 2.0 mm., on a 1.6 meter handle. The samples were obtained by dredging through the top few centimeters of substrate in about 1 meter of water. Since the bottom could not be seen at this depth, and all snails caught in the dredge were included in the samples, reasonably random samples probably were obtained. Since the smallest free-living snails collected measured 2.0 mm. in their smallest dimensions, free-living snails of all size classes were retained by the dredge.

Young snails were cultured in isolation in 4.5-inch fingerbowls containing natural substrate.

The histological preparations were fixed in Bouin's fixative, stained with Heidenhain's iron hematoxylin, and counterstained with eosin.

Population Analysis and Growth Rate: Collections made at all seasons were analyzed to determine growth rates. Length frequency graphs, indicating growth of the year classes through a one-year period, are shown. From March 17, 1956, to March 13, 1957, the mean length of the 1956 year class increased from 2.99



Length Frequency Graphs of Collections

± 0.18 mm. to 8.8 ± 1.4 mm. (standard errors). The March 17, 1956, collection seemed to show a 1955 year class which was traceable through the December 8, 1956, collection. During this time, the mean length of the 1955 year class increased from 10.1 ± 0.92 mm. to 15.4 ± 0.70 mm. After December, 1956, the 1955 year class was not distinct as a class in the population. At all times of the year there was a mode which fluctuated between 17 and 20 mm. This mode undoubtedly included the third year class and probably additional year classes as well. The largest snail collected in this study measured 27.3 mm. in length.

Two cultures of young snails taken from adults by dissection were maintained in the laboratory. These showed approximately the same growth rates as those found in nature. Measurements of their growth are shown in Table 1. The two individuals surviving in April, 1957, were dissected and found to have very small ovaries as are normal for this size class.

TABLE 1

Growth Rates of Young in the Laboratory

Collection	Jan.	Mar.	June	Sept.	Jan.	Apr.
Jan. 31, 1956	35 (3.0)	9 (5.0)	8 (5.5)	6 (7.0)	2 (11.2)	2 (14.8)
Mar. 17, 1956	—	10 (3.5)	8 (6.0)	3 (8.2)	0	0

The first figure indicates number of living young. The figure in parentheses indicates the average length of that group.

These results are in contrast with those reported by Medcof for a population of *C. decisum* in Ontario.

Feeding: No mention is made of the food of *Campeloma* in the literature. Medcof and Mattox, who have published on aspects of the life history in this genus, state that in their studies the food of the snails was not determined (personal communication). The feeding action has never been described, and in the present study no obvious feeding activity was observed. Starved snails placed on a thin film of mud under water did not feed at all. Allison ('42) described a method of trapping *C. rufum* in a slow stream by baiting a small area with chicken droppings. He concluded from the resulting aggregation of snails around the bait that the snails were feeding on it. In the present study, *C. decisum* in the laboratory avoided chicken droppings placed both above and below the surface of the substrate.

In collections from nature, snails dissected within three hours of time of collection usually had mud in the first portion of the

intestine, but after 3 hours mud could only be found in the rectum (as feces). After 5 hours, the gut was entirely clear.

Snails observed at the edge of the lake were almost always half-buried in the substrate, a clayey silt with some sand and decaying organic debris. Young have been maintained in the laboratory for 15 months with nothing but this substrate for food (see above). These observations seem to indicate that *C. decisum* feeds by ingesting bottom materials containing decaying organic matter.

Reproduction: Sexes are distinguished in living *Campeloma* by the appearance of the tentacles. In males the right tentacle is modified as a sheath for the intromittent organ and appears shorter and much blunter than the left. In females the tentacles are identical, both being long, thin, and pointed. On dissection females have a clearly defined uterus lying medial to the intestine and opening into the mantle cavity (Baker, '28).

Presence of males in populations of *Campeloma* has been studied by several authors. No males were found in over 1500 individuals of *C. rufum* from a stream in Illinois by Van Cleave and Altringer ('37). In a histological examination of 700 individuals of this species from the same locality, Mattox ('37) showed clear evidence of parthenogenesis.

A sex ratio of 1:99, males to females, was found by Baker ('28) in *C. decisum* from Wisconsin. Medcof ('40) found no males in 450 *C. decisum* from Ontario.

In this study, no males were found in over 800 individuals of *C. decisum,* as judged by appearance of the tentacles and presence of a uterus. Two individuals from each collection were studied histologically after the method of Mattox ('37). Only the early stages of meiosis (to anaphase of first meiotic division) were found. Two rather clear metaphase stages in oögonial division were found. Each of these showed 24 to 26 chromosomes.

The absence of males found in this and other studies seems to point toward parthenogenesis at least in some populations of this species. The problem of comparing results of studies on species of the genus *Campeloma* is greatly complicated by a confusion in the taxonomy of the group (Medcof, '40).

The ovaries studied were found to be most active in division

during the period from July to October. Mattox ('37) found most activity in October.

Medcof ('40) found the parturition period in *C. decisum* from Ontario to occur from March to September. In the present study, parturition was found to occur from mid-March until the end of June. The greatest release of young occurs in late March and early April. Size of intra-uterine young apparently is not the sole stimulus for parturition, since from October to March the average maximum size of intrauterine is greater than the minimum size of young released in nature (Table 2). The instigation of the release does not seem to be related to the water temperature at the time of release.

TABLE 2

Average maximum length (mm.) of intra-uterine young and lake temperature (10 day average, °C.) for winter 1956-1957 collections

Collection	Average length	Temperature[2]
Oct. 4, 1956	2.3	21.0
Nov. 5 1956	3.1	19.5
Dec. 8, 1956	3.4	15.5
Jan. 12, 1957	3.5	11.7
Mar. 13, 1957[3]	3.6	15.0

The smallest gravid snail found was 15.0 mm. in length (collection of August 8, 1956). Two others of this size class were also gravid. The 15 mm. size class in August is included in the 1954 year class, so age at sexual maturity is probably 2 years. At no time was a gravid snail found which belonged to a size class under two years old.

Parasitism: Some collections included snails infected with a metacercaria in the uterus (Table 3). This trematode was identified as *Leucochloridomorpha constantiae* (Mueller) by Dr. W. W. Cort. Allison ('43) described the life cycle of the trematode as occurring in the black duck (*Anas rubripes*) as an adult and passing the larval stages in *C. rufum.* The black duck is found commonly on University Lake in winter. Metacercariae were found only in the uteri of snails bearing young, a fact not previously reported.

[2]Temperatures are given as averages of five days before and four days after each collection. All temperature data were obtained from the Chapel Hill Water Works.

[3]This collection marks the beginning of parturition. Free-living young were not present on March 11, 1957.

TABLE 3
Percent of samples parasitized

Collection	No. of snails	% parasitized
Mar. 17, 1956	100	15.0
May 30, 1956	60	0.0
Aug. 13, 1956	65	0.0
Oct. 4, 1956	61	19.6
Nov. 5, 1956	62	8.1
Dec. 8, 1956	50	14.0
Mar. 13, 1957	89	4.5

SUMMARY

1. Population samples of *Campeloma decisum* (Say) taken over a period of eighteen months from University Lake, Chapel Hill, North Carolina, have been subjected to field and laboratory analysis.

2. The year class released in March has a mode of shell length at 3 mm. By the following October the mode is at 8 mm., and by March of the next year it is at 10 mm.

3. Immature snails were maintained in the laboratory for sixteen months with only natural substrate (clayey silt with some sand and decaying organic debris) for food.

4. No males were found in over 800 individuals examined.

5. Parturition occurs from mid-March to the end of June, being heaviest in late March and early April.

6. Average maximum size of intra-uterine young is greater than minimum size released in nature for five months prior to release of young.

7. The smallest gravid individuals found were 15 mm. in shell length, indicating two years as age of sexual maturity.

8. Infection of some snails by metacerceriae of *Leucochloridomorpha constantiae* was found.

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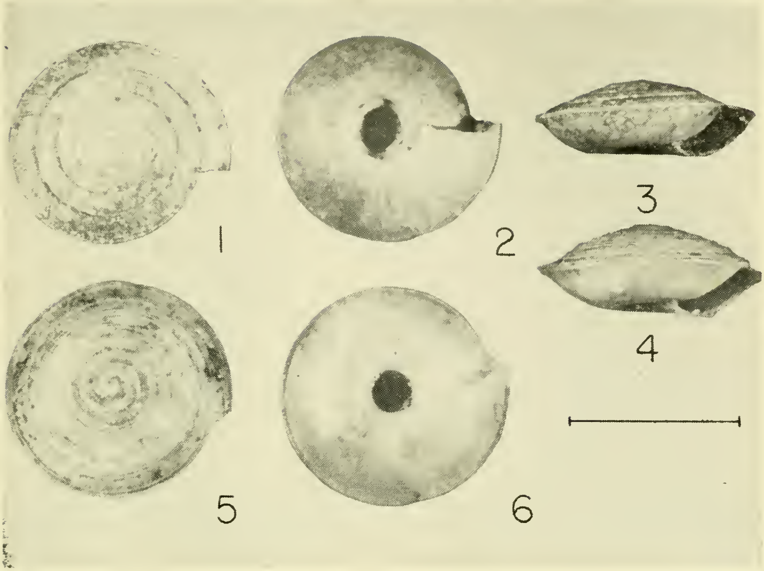
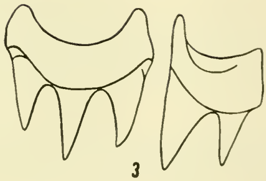


FIGS. 1-3. *Theskelomensor creon* Solem, holotype, University of Mich. Museum of Zoology 136666, 20 miles NW. of Cardwell, Queensland, Australia. FIGS. 4-6. *T. lizardensis* (Pfeiffer), Chicago Nat. Hist. Museum 46366, Lizard Island, North Queensland. Scale equals 5 mm.

FIG. 7. *Campeloma decisum*, ×2½, from drawing by Roger Davis.

4



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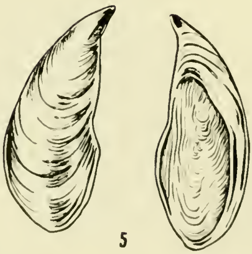

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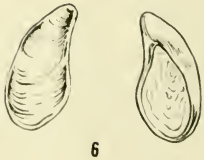

6

Vasum muricatum (Born): 1, shell ($3\frac{1}{4}$ inches long). 3, radula (central and right lateral) × 75. 5, operculum (at left is outer, at right, inner side) × 1. *V. capitellum* (Linne): 2, shell ($2\frac{1}{2}$ inches long). 4, radula (central and left lateral) × 75. 6, operculum (outer side at left, inner at right) × 1.

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RADULA AND OPERCULUM OF VASUM CAPITELLUM

By GERMAINE L. WARMKE
Institute of Marine Biology, University of Puerto Rico, Mayaguez

Vasum capitellum (Linné) previously has been reported from Puerto Rico, (Abbott, 1950), but to our knowledge, its radula and operculum have not been described.

This beautiful species is rarely found on the beaches. Following a strong hurricane in November 1956, K. O. and A. Phares found over 25 dead specimens of this species at Cabo Rojo Light House, at the southwestern tip of Puerto Rico. Most of the shells were in very good condition; many still had the periostracum, and the operculum was present in two of the specimens. The radula could be extracted from the decaying animal in one of the specimens. Most of the shells still retained a bright orange glaze on the parietal wall and in the aperture. The presence of this color may be a local characteristic or it may be due to the fact that the specimens were fresh. The presence of the color in *Vasum capitellum* was not mentioned in Linné's 1758 original description, nor in the "Johnsonia" monograph of *Vasum* (Abbott, 1950). The following notes were made from the specimens found at Cabo Rojo Light House, Puerto Rico.

The shell (Plate 4, figs. 1, 2) of *Vasum capitellum* (Linné) can easily be separated from the more common *Vasum muricatum* (Born) by its size (*capitellum* 2 to 3 inches. *muricatum* 2½ to 5 inches), by its elongated and fusiform shape, and by the number of plicae on the columella (3 in *capitellum,* 5 in *muricatum*). Color, when present on the columella and inner lip, is orange in *capitellum* and purple in *muricatum.* The epidermis in *capitellum* is light brown as compared to dark brown in *muricatum.*

The radula (Plate 4, figs. 3, 4) is a long narrow ribbon, ap-

proximately 10 mm. long in *V. capitellum* and 14 mm. long in *V. muricatum.* It is rachiglossate, each row of teeth possessing a tricuspid central tooth and bicuspid laterals. The central tooth of *capitellum* (Plate 4, fig. 4) is 126 microns wide by 93 microns high and the central tooth of *muricatum* (Plate 4, fig. 3) is 266 microns wide by 213 high.

The operculum (Plate 4, figs. 5, 6) fills most of the aperture in both species. It is horny, hard, unguiculate, curved, narrow at one end, and rounded at the other. The muscle scar covers ⅓ to ¾ the area of the inner side in both species. In *capitellum* it is marked with few widely spaced growth lines. The muscle scar of *muricatum* is marked with numerous closely set growth lines.

Although the shell of *Vasum capitellum* is quite different from that of *muricatum;* the radula and operculum seem quite similar, except in size.

The author wishes to thank K. O. and A. Phares for their generosity in lending their specimens for study. Laura Roark is responsible for the drawing. Dr. R. Tucker Abbott was kind enough to review the manuscript critically.

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TYPES OF MOLLUSKS DESCRIBED BY F. C. BAKER PART III, CHICAGO ACADEMY OF SCIENCES[1]

By DOROTHEA S. FRANZEN
Illinois Wesleyan University

For a period of approximately twenty years, 1894-1915, Frank C. Baker served the Chicago Academy of Sciences as its curator. Many of the types of the species and subspecies of mollusks which he described during that period of time are deposited in the museum of the Academy. Because there has been no listing of the holotypes and paratypes of that collection, I have prepared the following list. In some instances F. C. Baker designated a type series instead of a holotype and paratypes. From each of such series I have selected a lectotype. Each lectotype is identified by the catalogue number as given in the text of this paper

[1] Expenses incurred in travel necessary to prepare this list have been covered by Grant-in-Aid of the Illinois State Academy of Science.

and also by its dimensions. The measurements made by F. C. Baker are quoted whenever such are available. Others given are those as made by the author of this paper. The procedure followed in the preparation of this list is the same as of Parts I and II of this series.

Galba bulimoides cassi Baker, 1911, Chicago Ac. Sci. Sp. Pub. No. 3: 221-222, pl. 28, figs. 9-11.

Lectotype: 23948a. L., 8.5 mm.; W., 5.25 mm.; L. of ap., 5.0 mm.; W. of ap., 3.0 mm. (Baker, 1911, p. 221). Syntypes: 23948. (6 shells).

Type locality: Rose Canyon, near Pacific Grove, San Diego Co., Calif. (C. L. Cass!).

Galba doddsi Baker, 1911, Chicago Ac. Sci. Sp. Pub. No. 3: 203-204, pl. 27, figs. 5-8.

Lectotype: 23937a. L., 9.0 mm.; W., 4.5 mm.; L. of ap., 4.25 mm.; W. of ap., 2.5 mm. (Baker, 1911, p. 203). Syntypes: 23937. (3 shells).

Type locality: Hot Sulphur Springs, Colo. (G. S. Dodds!).

Galba neopalustris Baker, 1911, Chicago Ac. Sci. Sp. Pub. No. 3: 376-377, pl. 39, fig. 28.

Type: 24547.

Type locality: Orange, Orange Co., Va. (Bryant Walker!)

Galba palustris alpenensis Baker, 1911, Chicago Ac. Sci. Sp. Pub. No. 3: 315-316, pl. 33, figs. 26-33.

Types: 23486. Missing from the collection.

Type locality: Thunder Bay Island near Alpena, Alpena Co., Mich. (W. A. Nason!).

Galba palustris blatchleyi Baker, 1911, Chicago Ac. Sci. Sp. Pub. No. 3: 321-322, pl. 33, figs. 34-36.

Lectotype: 23626a. L., 20.0 mm.; W., 8.0 mm.; L. of ap. 8.5 mm.; W. of ap., 4.0 mm. (Baker, 1911, p. 321). Syntypes: 23626. (4 shells).

Type locality: Turkey Lake, Kosciusko Co., Ind. (L. E. Daniels!).

Limnaea ferrissi Baker, 1902, Bull. Chicago Acad. Sci. 3 (2): 277, pl. 31, fig. 26.

Type: 3458.

Type locality: Rock Run, Joliet, Ill. (J. H. Ferriss!).

Limnaea reflexa crystalensis Baker, 1904, Naut. *18* (1): 11.

Lectotype: 23634a. L., 28.0 mm.; W., 10.0 mm.; L. of ap., 12.0 mm.; W. of ap. 6.0 mm. (Baker, 1904, p. 11) Syntypes: 23634. (8 shells).

Type locality: Crystal Lake, McHenry Co., Ill. (Dr. N. H. Lyon!).

Limnaea reflexa iowaensis Baker, 1904, Naut. *18* (1): 10.

Type: 23520.

Type locality: Muscatine, Iowa. (Received from Bryant Walker).

Limnaea reflexa jolietensis, Baker, 1901, Naut. *15* (2): 17-18.

Lectotype: 23606a. L., 24.0 mm.; W., 8.0 mm.; L. of ap., 9.5 mm.; W. of ap., 5.25 mm. (Baker, 1901, p. 17). Syntypes: 23606. (3 shells).

Type locality: Rock Run, Joliet, Ill. (J. H. Ferriss!).

Limnaea woodruffi Baker, 1901, Bull. Chicago Ac. Sci. 2 (4): 229-230, text fig. p. 229.

Lectotype: 3425a. L., 11.0 mm.; W., 8.0 mm.; L. of ap., 8.0 mm.; W. of ap., 5.00 mm. (Baker, 1901, p. 229) Syntypes: 3425 (3 shells).

Type locality: Lake Michigan, Oak St., Chicago, Ill. (F. M. Woodruff!).

Lymnaea dalli Baker, 1907, Naut. *20* (11): 125-126.

Lectotype: 23125a. L., 4.5 mm.; W., 2.5 mm.; L. of ap., 2.0 mm.; W. of ap., 1.1 mm. (Baker, 1907, p. 125). Syntypes: 23125. (5 shells).

Type locality: Marsh, west side Lake James, Steuben Co., Ind.

Lymnaea danielsi Baker, 1906, Naut. *20* (5): 55-56.

Lectotype: 23622a. L., 27.5 mm.; W., 11.5 mm.; L. of ap., 12.5 mm.; W. of ap. 6 mm.

Type locality: Lake Maxinkuckee, Ind. (L. E. Daniels!). Syntype: 23622. (1 shell).

Lymnaea emarginata wisconsinensis Baker, 1910, Naut. *24* (5): 58-60.

Lectotype: 24504a. L., 27.0 mm.; W., 19.0 mm.; L. of ap., 18.0 mm.; W. of ap., 14.0 mm. Syntypes: 24504. (18 shells).

Type locality: East shore Tomahawk Lake, Oneida Co., Wisc.

Lymnaea hendersoni Baker, 1909, Naut. *22* (12): 140-141.

Lectotype: 24537a. L., 6.0 mm.; W., 4.5 mm.; L. of ap. 3.9 mm.; W. of ap. 3.6 mm. Syntypes: 24537. (5 shells). (No. 24534 as designated in type description is an error).

Type locality: West of Fort Collins, Laramie Co., Colo.

Lymnaea hinkleyi Baker, 1906, Naut. *19* (12): 142-143.

Lectotype: 23720a. L., 15.25 mm.; W., 9.25 mm.; L. of ap., 10.5 mm.; W. of ap., 3.5 mm. (Baker, 1906, p. 142). Syntypes: 23720. (4 shells).

Type locality: North Fork Snake River, east Idaho. (A. A. Hinkley!).

Lymnaea jacksonensis Baker, 1907, Naut. *21* (5): 52-54.

Lectotype: 23806a. L., 19.0 mm.; W., 10.0 mm.; L. of ap., 10.1 mm.; W. of ap., 5.0 mm. (Baker, 1907, p. 53). Syntypes: 23806. (3 shells).

Type locality: Jackson Lake, drained by the south fork of the Snake River, Wyo. (H. O. Hinkley and A. A. Hinkley!).

Lymnaea leai Baker, 1907, Naut. *20* (11): 126-127.
Type: 23653. Missing from the collection.
Type locality: Near San Francisco, Calif. (W. A. Nason!).

Lymnaea nasoni Baker, 1906. Trans. Acad. Sci. St. Louis *16*: 12, pl. 1, figs. 1-4.
Lectotype: 23788a. L., 10.0 mm.; W., 6.75 mm.; L. of ap., 7.0 mm.; W. of ap., 5.0 mm. (Baker, 1911, p. 397) Syntypes: 23788. (2 shells).
Type locality: Thunder Bay Island, near Alpena, Alpena Co., Mich. (W. A. Nason!).

Lymnaea nashotahensis Baker, 1909, Naut. *23* (2): 19-21.
Types: 24539. Missing from the collection.
Type locality: Marl beds, Nashotah, Waukeshaw Co., Wisc. (F. M. Woodruff!).

Lymnaea owascoensis Baker, 1905, Naut. *18* (12): 141.
Lectotype: 23137a. L., 8.5 mm.; W., 3.5 mm.; L. of ap., 3.5 mm.; W. of ap., 2.0 mm. (Baker, 1905, p. 141). Syntypes: 23137. (2 shells).
Type locality: Owasco Lake, N. Y. (Dr. Howard N. Lyon!).

Lymnaea pseudopinguis Baker, 1907, Naut. *21* (5): 54-55.
Lectotype: 23800a. L., 14.0 mm.; W., 8.0 mm.; L. of ap., 8.0 mm.; W. of ap., 4.3 mm. (Baker, 1911, p. 395). Syntypes: 23800. (4 shells).
Type locality: Crystal Brook, Long Island, N. Y.

Lymnaea randolphi Baker, 1904, Naut. *18* (6): 63.
Type: 23089. Paratypes: 23090. (Designated by Baker as cotypes).
Type locality: Marsh Lake, near Dyea Valley, Yukon Territory, Alaska. (P. B. Randolph!).

Lymnaea stagnalis var. *higleyi* Baker, 1905, Naut. *18* (12):142.
Type: 23050.
Type locality: Michipecoten Bay, north shore, Lake Superior. (Presented by J. H. Ferriss!).

Lymnaea stagnalis lillianae Baker, 1910, Naut. *23* (9): 112-113 and (10): 125-126.
Lectotype: 24554a. L., 42.0 mm.; W., 22.0 mm.; L. of ap., 26.0 mm.; W. of ap., 13.0 mm. (Baker, 1910, p. 112). Syntypes: 24554. (4 shells).
Type locality: Tomahawk Lake, Oneida Co., Wisc.

Lymnaea sterkii Baker, 1905, Naut. *19* (5): 51-52.
Lectotype: 23156. L., 7.75 mm.; W., 3.5 mm.; L. of ap., 3.5 mm.; W. of ap., 1.75 mm. (Baker, 1905, p. 51). Syntypes: 23155. (4 shells).
Type locality: Twelve miles west of Cleveland, Ohio. (Dr. Victor Sterki!).

Murex bituberculatus Baker, 1891, Proc. Rochester Ac. Sci. *1*: 133-134.

Type: 20702. (One shell in the collection; it is labelled "Type").

Type locality: Australia. (Presented by Geo. H. Laflin).

Murex haustellum Linné var. *longicaudus* Baker, 1892, Proc. Ac. Sci. Philadelphia for 1891:56.

Type: 20701. (One shell in the collection; it is labelled "Type").

Type locality: Red Sea. (Presented by Geo. H. Laflin).

Ocinebra jenksii Baker, 1899, Naut. *3* (7): 80-81.

Type: 20696. (One shell in the collection; it is labelled "Type").

Type locality: Not known. (Presented by Geo. H. Laflin).

Ocinebra rubra Baker, 1891, Proc. Rochester Ac. Sci. *1*:134-135,. pl. 11, figs. 6, 7.

Type: 20697. (One shell in the collection; it is labelled "Type").

Type locality: Not known. (Presented by Geo. H. Laflin).

Ocinebra wardiana Baker, 1891, Proc. Rochester Ac. of Sci. *1*: 134, pl. 11, fig. 5.

Type: 20698. (One shell in the collection; it is labelled "Type").

Type locality: Australia. (Presented by Geo. H. Laflin).

Planorbis bicarinatus portagensis Baker, 1908, Naut. *22* (4-5): 45.

Type: Missing from the collection.

Type locality: Portage Lake, on Fish River, Aroostook Co., Maine. (O. O. Nylander!).

Purpurea problematica Baker, 1891, Proc. Rochester Ac. Sci. *1*: 135-136, pl. 11, figs. 2, 3.

Lectotype: 20704a. L., 30.0 mm.; W., 17.0 mm.; L. of ap., 20.0 mm.; W. of ap., 8.0 mm. Syntype: 20704.

Type locality: Seta coast, Japan. (Presented by Geo. H. Laflin).

Ricinula (Sistrum) rugosoplicata Baker, 1892, Proc. Ac. Nat. Sci. Philadelphia for 1891: 58-59.

Type: 20703. (One shell in the collection; it is labelled "Type").

Type locality: Turtle Bay, Lower California. (Presented by Geo. H. Laflin).

Sphaerium lilycashense Baker, 1898, Naut. *12* (6): 65-66.

Lectotype: 18105a. L., 14.0 mm.; H., 11.0 mm.; B., 8.5 mm. Syntypes: 10106, 18105. (14 shells).

Type locality: Lilycash Creek, Joliet, Ill. (J. H. Handwerk!).

NOTES AND NEWS

Dates of Nautilus.—Vol. 71, no. 1, pp. 1-36, pl. 1, was mailed Aug. 16, 1957. No. 2, pp. 37-72, pls. 2-4, Nov. 4, 1957. No. 3, pp.

73-116, pls. 5-9, Mar. 4, 1958. No. 4, pp. 117-152, i-viii, pls. 10-12, April 24, 1958.—H. B. B.

Mary E. (Jones) Bales.—All malacologists will hear with sorrow of the death of Mrs. Blenn R. Bales, after a short illness, on November 14, 1957, in Circleville, Ohio. She was born Aug. 7, 1881, in the same town, and was married to Dr. Bales (1876-1946, Naut. 60:101) on June 6, 1900. They are survived by their daughter, Mrs. B. R. Deming, and son, Blenn D., to whom our deepest sympathies are tendered.—H. B. B., C. B. W. and R. T. A.

A Sinistral shell of Cepaea hortensis.—During seven summers of collecting the land snail *Cepaea hortensis* at Cape Ann, Massachusetts, I have handled many hundreds of specimens. I have also examined several dozen shells in private collections which had been obtained from the same locality. Only once did I ever see a left-handed specimen. This was collected on August 12, 1957, on Barberry Shore of East Gloucester. In the same collection there were 309 other specimens. Of these, 194 were all yellow (bandless), 101 had five bands (1-2-3-4-5), 11 were banded but with no. 2 band missing (1-0-3-4-5), and three were banded but with no. 3 band missing (1-2-0-4-5). The sinistral specimen had five bands and measured 13 mm. high by 20 mm. wide. It has been given to the Museum of Comparative Zoölogy at Harvard University.—Ralph W. Dexter, Department of Biology, Kent State University, Kent, Ohio.

Columella edentula in California.—While collecting small insects in the vicinity of Mendocino, Mendocino Co., California, Jaques R. Helfer obtained some small land snails which he submitted for identification. One lot of these contained over 90 specimens of *Columella edentula* (Draparnaud)—a new record of this species for the State. Associated with the *Columella,* which were of all ages, were a few specimens of *Vertigo rowelli* (Newcomb). According to Mr. Helfer, the snails were collected by beating salmonberry bushes *(Rhus spectabilis)*; they were not found among other species of bushes, such as thimbleberry, that are prevalent in the area.—Allyn G. Smith, Calif. Acad. Sci.

Theskelomensor.—Although smoothish arionoid or limacoid shells present few tangible features, this "genus" (Cf. Solem, this no.) might belong in the Helicarioninae, which do occur in

Australia, and to which *Inozonites* and *Pareuplecta* apparently belong. But it might be a local endodont, as Brazier guessed. Are its apical whorls any smoother than those of *Helicodiscus singleyanus?* In any case, the only characteristic of *"T." creon* or *lizardensis* which seems vaguely reminiscent of the ariophantine *Euplecta* of India is the superficial outline of their shells, and an attempt to add "an Asian element" on such flimsy evidence would be a wild flight of wistful fancy.—H. B. B.

PUBLICATIONS RECEIVED

Die Baenderschnecken. Schluss: die Baenderschnecken Europas. By F. A. & Maria Schilder. Pp. 93-206, 7 figs. & 47 maps. Gustav Fischer, Jena. 30.30 marks. 1957.—This concludes the Schilders' detailed studies on *Cepaea* (Cf. Naut. 67:140) and extends them to all Europe. They decide that the 4 species differentiated anatomically and physiologically, but with less usable shell characters, since the end of the Tertiary, and underwent parallel mutation. The dispersal was largely passive and adventitious. Some of the color forms became widely distributed, but others, which may have originated only once, have remained relatively local, regardless of ecologic factors. The cases of sporadic distribution are explained by replacement in intervening areas. But might they not be interpreted as the simple chance of small numbers, which might be expected in either adventitious dispersal or rare mutations?—H. B. B.

A historical review of the mollusks of Linnaeus. 5. The genus Murex of the class Gastropoda. By Dodge, Henry. Bull. Amer. Mus. Nat. Hist. 113 (2) :73-224. 1957—This exhaustive study of the over 60 species included by Linné in *Murex,* contains repetitions of the original diagnoses, discussions of nomenclatural history, and citations of published figures. The bibliography cites over 300 references—H. B. B.

Taxionomische Revision palaearktischer Zonitinae, I. By Lothar Forcart. Arch. f. Mollusk. 86:101-136, 19 text-figs. 1957.—For students of U. S. zonitids, the principal contribution of this excellent study is that it clearly proves, for the first time, that *Retinella* is more like *Mesomphix, Glyphyalinia* and *Vitrinizonites* than like *Nesovitrea,* of which *Perpolita,* type species *Helix electrina* Gould,[1] is at best a poorly marked section. Whether the

relative degrees of development of a zonitid vas-epiphallus (not a true penial one) be usable for generic separation is still open to question. In any case, to claim that *Nesovitrea* (s.s.) lacks a vas-epiphallus while its subgenus *Aegopinella* has one, is a distinction of degree rather than of palpable difference.

On the whole, *Retinella* s.s. seems more like *Mesomphix* (the prior name) with its similarly large shell, than like the *Glyphyalinia* series. It differs markedly from the subgenus *Glyphyalus*, in which the spermathecal sac is imbedded in the albumen gland above the aorta ("long type"), and also from the subgenus *Glyphyalinia*, which has peculiarly serrate marginals and a papillate apical chamber in its penis.

Shortly after my first (1928) fumbling attempts to classify the Nearctic zonitids, Hugh Watson (in letters) objected that the principal break in the Zonitinae was between: (1) Those with the atrial opening in the visceral stalk, with the right eye retractor free from the genitalia, and with no penial nerve from cerebral ganglia (Nesovitreinae Cooke). (2) Those with the atrial opening near the right ommatophore and with the latter's retractor in the penioviducal angle (typical Zonitinae). Obsessed with other ideas, I was too slow to agree with him, but now do so thankfully. For the same reason, Thiele in his "Handbuch" probably was sensible when he used *Paraegopis* as a subgenus of *Zonites*. However, Forcart's remark (p. 114) about the right eye retractor ("Seine Lage bei den nearktischen Arten wurde nicht bescrieben.") only shows that he did not read my keys carefully (Cf. 1928, op. cit., pp. 14 & 15; also 1931, Proc. ANSP. 83:86). The typical Zonitinae (e. g., *Oxychilus*) apparently are not native to North America, but the nesovitreine division includes my "Retinellae" (*Nesovitrea*), Mesomphices and Glyphyaliniae, and also the highly differentiated genera *Paravitrea* and *Pilsbryna* (misspelled by Forcart, p. 106).

The other principal objection to Dr. Forcart's key would be his emphasis on the penial appendix or caecum ("flagellum" best retained for the epiphallic one). In both the *Glyphyalinia* series and in *Mesomphix*, its development or absence exhibits almost every degree of intergradation, even in obviously similar species.

[1]Realizing the dubious identity of the European and U. S. species and that the simplified shell characters of the zonitines were mainly of little utility, I plainly stated (1928, Proc. ANSP. *80*:15:) "type *Helix hammonis* Strom, but from Cheboygan County, Michigan (my material)."

THE NAUTILUS

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DREPANOTREMA PAROPSEIDES (PLANORBIDAE)

By W. LOBATO PARAENSE and NEWTON DESLANDES[1]
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The present species was originally described in *Planorbis* by Orbigny (1835, 1837), who found it in the marshes formed by the river Rimac, in the outskirts of Callao, Peru. In November, 1956, the senior author collected a sample of it in that same place, where it occurs with *D. kermatoides,* as recorded by Orbigny (1837).

The following study was performed on a sample of 37 shells and on the internal organs of 15 dissected specimens. Serial histological sections from two whole specimens were also observed. Ten shells and three dissected specimens were deposited in the collection of Instituto Oswaldo Cruz (no. 7652).

DESCRIPTION: The shell (pl. 5, fig. 1) is thin, amber in color and translucent in those specimens not incrusted with environmental material, and very finely obliquely striated. The largest specimens were 6 mm. in diameter and between 1 and 1.25 mm. in width, and had 6 whorls. Both sides are very shallowly concave, the right side a little more than the left one; as the concavity increases on one side, the other side shows a corresponding tendency to planeness. The intersection of the two sides forms a blunt carination along or very near the extreme left of the periphery. The whorls increase slowly, are separated by a distinct suture and are plainly visible on both sides. Each whorl overlaps laterally its predecessor, to a less extent on the left than on the right side, so that, on the outer whorl, the distance between the suture and the periphery is greater on the right than on the left side. The lateral curvature of the whorls is more pronounced on the right than on the left. The aperture is narrow, oblique and heart-shaped. Its left wall tends to be

[1] This work was aided by the Conselho Nacional de Pesquisas of Brazil, which defrayed the expenses of a trip by the senior author to the type locality of *D. paropseides* and also provided additional facilities for the study of the material collected there.

plane, whereas the right wall is convex, and depressed in most specimens.

The animal in locomotion carries the shell at the left, nearly parallel to the substrate. The exposed soft parts are light gray. The pigment is diffusely distributed, except on the head and the antennae, where it is particularly concentrated, and on the mantle, where there is an unpigmented spot just behind the mantle collar (fig. 2). The right ventral portion of the mantle collar projects forwards, covering a small extent of the beginning of the outer whorl. A simple pseudobranch projects downwards, as a very small cone, from the region of the anal opening. A low rectal ridge extends from the pseudobranch into the pulmonary cavity, dimming out along the nidamental gland.

The renal tube is very long and narrow, and shows no sign of renal ridge. The ureter opens out by a subterminal meatus. As in the other species of *Drepanotrema*[2] (except *D. nordestense*) previously studied by us, there is no dorsolateral ridge.

The genital organs are represented in figs. 3 to 6.

The ovotestis consists of a comparatively small number of short, unbranched, sac-like diverticula which increase in size from the caudal toward the cephalic end of the organ. The diverticula are arranged in a double series and empty into the collecting canal, which is ventrally situated. The ovisperm duct has a proximal segment which opens subterminally into the caudal end of the seminal vesicle. The latter is a moderately sinuous smooth-walled swelling of the ovisperm duct; it continues into the distal segment of the ovisperm duct, which is from the same length to thrice as long as the proximal segment, and empties into the carrefour.

The sperm duct is about twice as long as the ovisperm duct (including the not uncoiled seminal vesicle). Its distal end is hidden by the outpocketings from the female duct which are mentioned below. Then it continues into the prostate duct, which receives a single row of unbranched, finger-like or, less frequently, egg-shaped or pear-shaped prostate diverticula, the number of which varied from 27 to 41 in the examined material. In most instances, the distal portion of the finger-like diverticula loops back over the proximal portion. The vas deferens follows the

[2] *D. anatinum, D. melleum, D. depressissimum, D. cimex, D. nordestense* and *D. kermatoides* (see Paraense and Deslandes, 1956a, b, 1957, 1958a, b, c).

prostate duct and ends on the caudal extremity of the vergic sac, beside the attachments of the two retractor muscles and of the flagella. The vergic sac is comparatively long and contains a verge about as long. The verge (fig. 5) is unarmed and has an axial sperm canal with a terminal outlet. Histologically, the verge resembles that of the other species (except *D. nordestense*) previously studied by us, with the only difference that the internal (longitudinal) muscular layer is reduced to a small number of very slender fibers. Of the retractor muscles, one extends backwards to merge into the columella muscle, whereas the other extends forwards, inserting in the connective tissue around the base of the preputium (fig. 4). In many specimens, the vergic sac is bent by the action of the last mentioned muscle. Some specimens show two clearly visible flagella, but in some others only one seems to be present. The flagella are very short, sometimes rudimentary. The preputium is about as long as the vergic sac and distinctly wider. The two organs are separated internally by a muscular diaphragm. The preputial wall has two slim muscular pilasters.

The oviduct is from twice to four times as long as the nidamental gland; its cephalic end swells into a pouch similar to that already described in *D. melleum, D. depressissimum, D. cimex* and *D. kermatoides,* the walls of which show several small sac-like and finger-like outpocketings. The uterus is different from that of the other species, forming an elbow-like passage between the nidamental gland and the vagina. Its wall has a reinforced muscular coat, and its inner surface is lined with a villous epithelium (fig. 6). The vagina is tubular and comparatively long. A striking peculiarity of this species is that it has no spermatheca.

The jaw is similar to that of the other species of *Drepanotrema,* consisting of many small plates arranged in a single horseshoe-shaped piece. The radulae of six specimens showed the following characteristics: formula 17-1-17 to 29-1-29, with 133 to 196 horizontal rows; central tooth bicuspid, with a small denticle high on the lateral side of each cusp; 3 to 7 laterals, sometimes with a small denticle high on the entocone and/or the ectocone; 4 to 6 intermediates; 7 to 16 marginals. The radula teeth are shown in fig. 7.

Comparison with related species: The shell of *D. paropseides* is so different from those of *D. anatinum* and *D. nordestense* (for comparison, see Paraense and Deslandes, 1956a, 1958b), that separation of these species on the basis of the shell characters presents no difficulty.

The shell of the present species resembles those of *D. melleum, D. depressissimum, D. cimex* and *D. kermatoides,* but it differs in some characteristics. It is smaller than the others, except *melleum.* The greatest dimensions so far recorded for the five species are the following, in decreasing order (diameter $\times$ height): *kermatoides,* 13 $\times$ 1.75 mm.; *depressissimum,* 9.5 $\times$ 1 mm.; *cimex,* 8.5 $\times$ 1.5 mm.; *paropseides,* 6 $\times$ 1.25 mm.; *melleum,* 5.5 $\times$ 1.5 mm. The ratio, diameter divided by height, may also be arranged as follows: *depressissimum,* 9.50; *kermatoides,* 7.43; *cimex,* 5.66; *paropseides,* 4.80; *melleum,* 3.66; this means that *paropseides* is intermediate, in relative height, between the higher *melleum* and the lower *cimex.* The peripheral carination is very sharp in *depressissimum,* less marked in *cimex* and *kermatoides,* and scarcely perceptible as a blunt subangulation in *melleum*; in *paropseides,* it is intermediate between the more rounded *melleum* and the more angular *cimex* and *kermatoides.*

The shell of *paropseides* is closely similar to those of *melleum, cimex* and *kermatoides.* The existence of intergrades sometimes renders difficult their distinction by the shell characters.

As regards the genital organs, the following characters of *paropseides,* as compared with those of the closely related species *melleum, cimex, kermatoides* and *depressissimum,* will be useful to separate it from the latter. The seminal vesicle is sinuous, as in *melleum, kermatoides* and *depressissimum,* not uncoiled as in *cimex.* The sperm duct (or the oviduct) is about twice as long as the ovisperm duct, whereas it is about one and a half times as long as the latter in *melleum, kermatoides* and *depressissimum,* and about the same length in *cimex.* The prostatic diverticula are long and their distal portion usually loops back over the proximal portion, as is the rule in *depressissimum* and sometimes occurs in *melleum* and *kermatoides*; they are short and ovoid in *cimex.* The two flagella are very short, as in *kermatoides* (as in the latter, sometimes only one seems to be present); in *melleum* and *depressissimum* there are always two long flagella, and in

cimex there is only a very short one. And finally, as the most characteristic features of *paropseides,* the projecting cap-shaped uterus and the absence of a spermatheca should be mentioned.

Acknowledgments: We are indebted to Dr. Aristides Herrer, from the Instituto Nacional de Higiene y Salud Publica of Peru, for his helpful assistance to the senior author during the work in Callao.

Summary

The planorbid species, *Drepanotrema paropseides* (Orbigny, 1835), is defined anatomically. Its diagnostic characters are the following:

Shell up to about 6 mm. in diameter and 1 mm. in width, periphery subcarinate. Absence of renal and dorsolateral ridge. Ovotestis diverticula simple, sac-like, arranged in a double series. Seminal vesicle moderately sinuous. Prostate diverticula unbranched, predominantly long and finger-like, less frequently egg-shaped or pear-shaped, and arranged in a single row. Two very short flagella (sometimes only one seems to be present) on the caudal end of the vergic sac. Vergic sac about as long as the preputium. Pouch of the oviduct with sac-like and finger-like out-pocketings. Uterus clearly distinguishable as a cap-shaped projection between the nidamental gland and the vagina. Absence of spermatheca.

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Explanation of Plate 5

Genital organs (figs. 3-6) : ca, carrefour, fl, flagellum. ng, nidamental gland. od, od', proximal and distal segments of ovisperm duct. ot, ovotestis. ov, oviduct. po, pouch of oviduct. pp, preputial sac. pr, prostate. rm, retractor muscle. sd, sperm duct. sv, seminal vesicle. ut, uterus. va, vagina. vd, vas deferens. vs, vergic sac.

Radula (fig. 7) : C, central. I, intermediate lateral. L, lateral. M, marginal.

SYSTEMATIC STATUS OF HEMPHILLIA MALONEI

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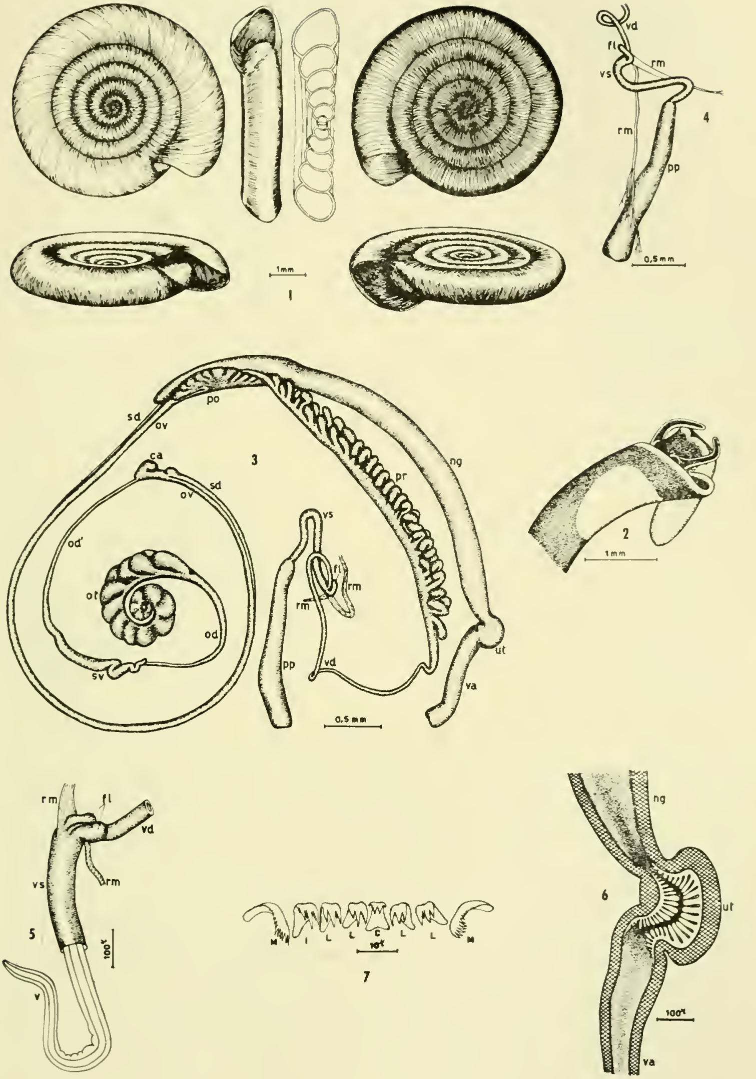
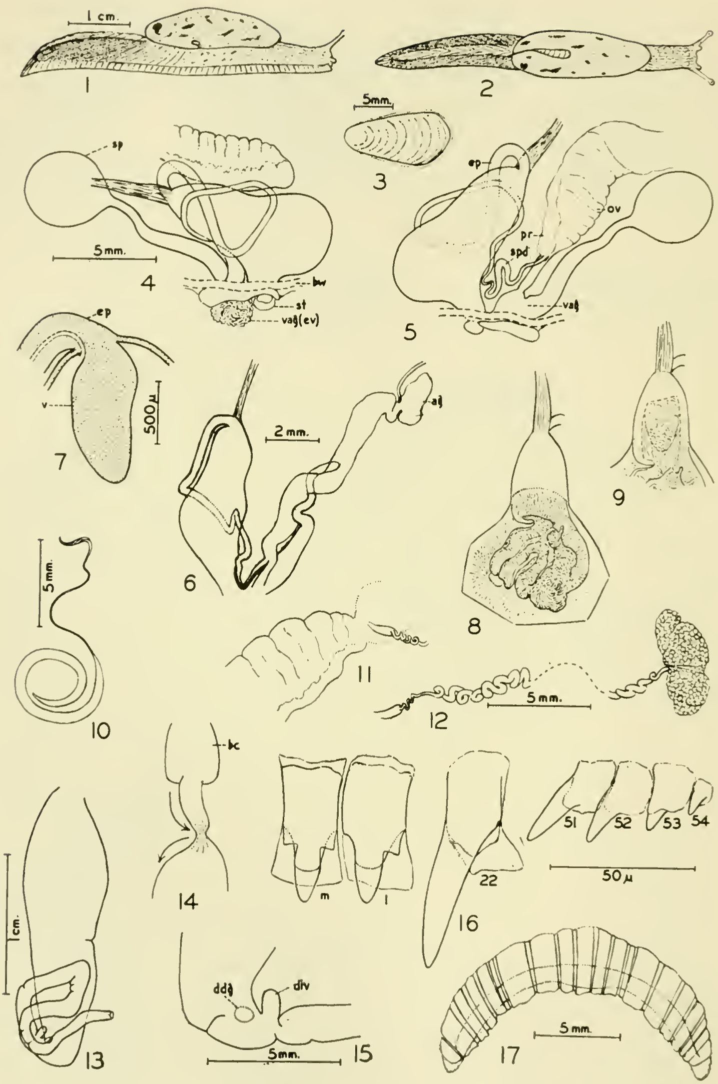
The arionid slug *Hemphillia malonei* was described by Pilsbry (1917) from a single specimen collected by J. G. Malone near Tawney's Hotel, on the Salmon River (in Clackamas County) about 12 miles west of Mount Hood, Oregon. The elevation was given as 1,600 feet. The preserved specimen on which Pilsbry's description was based was not in good condition for dissection, and Pilsbry himself stated (1948) that *H. malonei* should remain a doubtful species, probably identical with *H. camelus* Pilsbry and Vanatta (1897), although the latter has not definitely been recorded outside of Idaho.

W. O. Gregg, in a personal communication to Pilsbry in 1946, stated that he found a slug on the Mount Hood Loop Highway (in Hood River County, a few miles northeast of Mount Hood) which appeared to be *H. malonei*. A brief description of the external features of this slug, as given by Gregg, is quoted by Pilsbry (1948), but up to the present time no additional information on this specimen has been published. Pilsbry also quoted a description, given by P. B. Randolph, of a slug found in 1899 at Eagle Gorge, King County, Washington, which Randolph thought to be similar to *H. camelus*. Possibly, a *Hemphillia* from this locality could be identical with *H. malonei*. Hanham (1929) referred to *H. malonei* some specimens of a black slug collected on Mount Brenton, Vancouver Island, at an elevation of about 3,500 to 4,000 feet. Until material from this region can be studied more thoroughly, it appears unwise to assign the specimens reported by Hanham to *H. malonei*.

In July, 1952, seven specimens of a *Hemphillia* were collected under rotting logs near the public picnic ground on Larch Mountain, Multnomah County, Oregon, at an elevation of approximately 3,900 feet. Since then, thirteen additional examples have been taken at the same locality. Eight specimens have also been found at various times in the last few years in the canyon of Eagle Creek (near Bonneville Dam), at an elevation of only about 200 feet, close to the point where the canyon is intersected by the boundary between Multnomah County and Hood River County. The type locality, the two localities from which our



Drepanotrema paropseides. 1, shell. 2, cephalic end of animal. 3, genital organs. 4, penial complex. 5, vergic sac excised to show verge. 6, longitudinal section from nidamental gland through uterus to vagina. 7, radular teeth.



Hemphillia malonei: ag, albumen gland. bw, body wall. ddg, opening of duct of digestive gland. div, diverticulum. ep, epiphallus. ov, oviduct. pr, "prostate" (obscuring sperm duct). sp, spermatheca. spd, sperm duct (free portion). st, stimulator. v, verge. vag, vagina. vag (ev), vagina, everted.

material was collected, and the locality mentioned by Gregg all lie within about 30 miles of one another.

Because the slugs from Larch Mountain and Eagle Creek appeared to be conspecific with *H. malonei,* they have been studied with a view to determining the relationship between *H. malonei* and *H. camelus.* We have concluded that *H. malonei* should be regarded as a valid species quite distinct from *H. camelus.*

External features. The general appearance of the slugs from Larch Mountain and Eagle Creek (pl. 6, figs. 1, 2) is essentially like that of *H. camelus.* The figures and descriptions of *H. camelus* given by Pilsbry (1948) and Pilsbry and Vanatta (1898) suggest that *H. malonei* and *H. camelus* could not be separated on the basis of form and pigmentation.

The largest specimens studied measured approximately 60 mm. in length when extended and in movement. The length of the head was about 10 mm., the length of the mantle about 23 mm., and the length of the tail about 27 mm. The eye-bearing tentacles were about 6 mm. long. The width of the mantle was about 8 mm. and the width of the tail about 6 mm. As in all species of *Hemphillia,* the mantle is elevated into a conspicuous visceral hump. The posterior half of the tail is somewhat keeled above. The tail is capable of remarkably rapid wagging and coiling movements.

The dorsal surface of the head is generally light brown, becoming grayer toward the ventral surface and posteriorly toward the mantle. The sides of the foot below the mantle are grayish, with scattered small masses of dark pigment. The mantle is gray, with a tinge of brown, and streaked and spotted with black pigment. In some specimens the streaks and spots are larger and more distinct than in others. As a rule, the black pigmentation on the mantle is more abundant on the sides than on the dorsal surface. The dorsal part of the tail is light brown. This light brown streak is bordered on the sides by a more heavily pigmented zone, which appears dark brown in color. The vertical grooves on the margin of the foot are accentuated by flecks of pigment. At the end of the tail, below the caudal pore, the margin is wider. Ordinarily, living specimens do not show a downward projection ("caudal horn") of the end of the tail above the caudal pore. Some of the specimens we studied, however, showed such a pro-

jection, but it was never as conspicuous as the one described for *H. glandulosa* Bland and Binney. The sole is very light and without black pigmentation.

The pneumostome is situated a short distance posterior to the middle of the mantle. In the largest specimens, dimensions of which are given above, the exposed area of the shell measured approximately 7 mm. by 3.5 mm. Removed from the mantle, the shells of these individuals measured approximately 15 mm. by 8 mm. Between the exposed area of the shell and the posterior end of the mantle, there is a longitudinal slit, the edges of which are continuous with the edges of the mantle bordering the area through which the shell is exposed. The shell (fig. 3) consists of a flexible, hyaline yellowish-brown plate, beneath which there is a delicate membrane. In larger individuals, there is usually a thin calcareous deposit between this membrane and the external plate. The external plate is weakly marked by concentric lines of growth.

Anatomy of genitalia and digestive tract: The large ovotestis (fig. 12) is situated at or near the posterior end of the visceral mass, and is embedded in the digestive gland. It is darkened by blackish-brown pigment. In fully mature specimens, the hermaphroditic duct is greatly convoluted. Near the point where it enters the albumen gland (fig. 11), the duct becomes very slender, then dilates abruptly into a structure which may possibly be comparable to the so-called fertilization chamber described for *Helix* and certain other pulmonates. This structure is not evident in younger individuals, and sinuations of the hermaphroditic duct may be absent or noted only in that portion of the duct which is closest to the albumen gland. The albumen gland of *H. malonei* is rather well-developed, even in specimens which are not completely mature (fig. 6).

In younger examples, the spermatheca is not much thicker than the upper portion of its duct, but in fully mature individuals the spermatheca is comparatively large and globose (figs. 4, 5). The duct is often sharply kinked close to the spermatheca itself, and becomes gradually wider as it passes toward the vagina.

In each of three completely mature specimens available to us (collected on Larch Mountain, October, 1954), the spermatheca contained spermatophores. Four spermatophores were found in

each of two of these slugs, and three in the other. About one-half the length of the spermatophore of *H. malonei* (fig. 10) is composed of a relatively stout portion. The other half is mostly very slender, but becomes thickened close to its free end. From this thickened portion to the tip, and also in the middle section of the more slender part, the surface of the spermatophore is conspicuously sculptured. The color is yellowish. Evidently spermatophores have not previously been reported for any species of *Hemphillia*. The place at which the spermatophores of *H. malonei* are elaborated has not been established.

The vagina is always rather short, but its form in our material is variable. The differences, at least in mature and nearly mature individuals, probably depend to a large extent upon the state of contraction which the thick-walled and more muscular elements of the reproductive system near the genital pore are in at the time of preservation. In some individuals which have been killed in a relatively relaxed condition by drowning, the genital pore is greatly dilated, and the genital atrium and much-folded lining of the vagina are partially everted. This was the case in the fully mature specimen whose genitalia are shown in fig. 4. Pressure on the everted vagina pushed it back into a more or less cup-shaped condition (fig. 5). However, in the other two fully mature specimens, which also showed a dilated genital pore when they were preserved, the vagina had the appearance of being a gradually widening continuation of the duct of the spermatheca, below the point where this duct was entered by the decidedly less prominent oviduct. The configuration in specimens which are almost mature (fig. 6) is similar to this, even when the genital pore is not particularly dilated.

At the point where the sperm duct emerges as a separate structure, it is considerably thinner than the free portion of the oviduct. As it approaches the penis it may show some thickenings, but at the base of the penis the sperm duct is typically very slender (figs. 5, 6). The duct thickens again as it passes alongside the penis to become the epiphallus, and in mature specimens it forms one or more loops as it is folded on the wall of the penis. The retractor muscle of the penis is attached partially to the upper end of the penis and partially to the epiphallus at the point where the latter enters the penis. This is essentially in

agreement with the statement in the original description of *H. malonei* (Pilsbry, 1917) to the effect that the penial retractor is inserted at the origin of the epiphallus. In *H. camelus,* according to Pilsbry (1948), the retractor is inserted upon the epiphallus a short distance from the place where the latter joins the penis. This disagrees with a statement (supported by an illustration) published by Pilsbry and Vanatta (1898) to the effect that the retractor muscle of *H. camelus* is inserted at the "root" of the epiphallus (i.e., the point of its junction with the penis).

When opened, the penis shows a stout verge (fig. 9) which is about twice as long as broad. In mature examples, the surface of this structure is greatly folded, but is less so in younger specimens. The sperm duct within the epiphallus opens into the penis to one side of the base of the attachment of the verge. This is evident in serial sections of the upper portion of the penis, as well as in cleared whole mounts of the verge and adjoining portions of the epiphallus and penis (fig. 7). According to Pilsbry (1948) the verge in *H. camelus* is perforated close to one edge by the sperm duct, which opens laterally near the end of the verge.

The penis of mature specimens of *H. malonei* is characterized by an extensively developed stimulator, which consists basically of two portions, both arising from the thickened lining of the upper part of the penis and extending to the point where the penis opens into the genital atrium (fig. 8). In preserved specimens, the distal end of one or both of these portions may be found protruding through the dilated genital pore (figs. 4, 5). The tissue of the stimulator is considerably folded. One of the portions of the stimulator is a relatively short, ribbon-like elaboration adherent to the wall of the penis. The other portion is more extensive; its two ribbon-like sections are separated by a conspicuous but poorly-defined corrugated mound, the folds of which pass insensibly into those of the wall of the penis. The wall of the lower part of the penis is relatively thin, and its lining is quite smooth except in the region of the opening into the genital atrium. The thickened lining of the upper part of the penis, which encloses the verge and from which the elaborations constituting the stimulator arise, is in its lower portion free from the wall of the penis (figs. 8, 9). This thickened lining, as well as the processes of the stimulator, may be scarcely devel-

oped in specimens which are not completely mature.

The general form of the alimentary canal (figs. 13, 14) is similar to that of *H. camelus,* as figured by Pilsbry (1948) and Pilsbry and Vanatta (1898). However, in *H. malonei* there is a rather conspicuous diverticulum of the intestine just posterior to the point of entrance of the ducts from the digestive gland. This diverticulum has been found in all specimens which we have dissected.

In larger specimens, the jaw (fig. 17) is composed of about 18 or 20 flat ribs of varying width. Most of the ribs are distinctly separated from one another by more transparent intervals. In the wider portions of the radula, the number of teeth in each transverse row has been found to reach 111 (55 on either side of the median tooth). The maximum number of transverse rows has been observed to be about 90. The median teeth (fig. 16, m) are tricuspid. The laterals near the median teeth lack the entocone; farther laterally the ectocone disappears as the mesocone becomes more than twice as long as it is in the median teeth, and this then progressively diminishes in size in the teeth nearer the margins of the radula.

Discussion. Although the general appearance of the slugs from Larch Mountain and Eagle Creek is very similar to that described for *H. camelus,* the anatomy of the genitalia and digestive tract in our specimens suggests that they represent a species distinct from *H. camelus.* The fact that the sperm duct opens into the penis at one side of the base of the attachment of the verge appears to be a significant difference. The insertion of the retractor muscle of the penis jointly upon the penis and the epiphallus is characteristic of our specimens, but apparently not of *H. camelus.* In the work of Pilsbry (1948), the vagina of *H. camelus* is said to be moderately long, about equal to the spermathecal duct, but the figure does not show this clearly. As also should be noted, the figure of the genitalia of *H. camelus* published earlier by Pilsbry and Vanatta (1898) shows a relatively short vagina.

The presence of a small diverticulum in the intestine, posterior to the entrance of the ducts from the digestive gland, has not been reported in the published descriptions of any species of *Hemphillia.* It cannot, of course, be stated with certainty that

such a diverticulum is found only in *H. malonei,* for it may have been overlooked by workers who have studied other species of the genus.

In view of the differences in the anatomy of the reproductive system and apparently also the alimentary tract of *H. camelus* and the slugs referable to *H. malonei,* it appears logical to regard *H. malonei* as a valid species closely related to *H. camelus.* The ranges of the two species, as they are understood at present, are widely separated, as *H. camelus* is not known definitely to occur outside of Idaho and *H. malonei* has been recorded only in the Cascade Mountains in northern Oregon.

Summary

Specimens of a *Hemphillia* collected on Larch Mountain, Multnomah County, and in the canyon of Eagle Creek near the boundary of Multnomah County and Hood River County, Oregon, appear to be conspecific with *H. malonei* Pilsbry. Although *H. malonei* has been considered doubtfully distinct from *H. camelus* Pilsbry and Vanatta, the anatomy of the reproductive system and digestive tract of the slugs from Larch Mountain and Eagle Creek differs in certain respects from that of *H. camelus. H. malonei* should be regarded as a distinct species very closely related to *H. camelus.*

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Explanation of Plate 6

All figures are of *Hemphillia malonei.* Figure 1, living animal, from right side. 2, dorsal view. 3, shell. 4, genitalia of mature specimen, dorsal view; vagina everted; stimulator protruding through genital pore. 5, genitalia of same individual, ventral view; organs separated for clarity; vagina pushed back into inverted position. 6, genitalia of nearly mature individual. 7, diagram of upper portion of penis of immature individual, showing sperm duct entering to one side of verge. 8, penis from genitalia shown in figs. 4 and 5, opened to show stimulator and thickened lining of upper portion of penis. 9, upper portion of penis opened to show verge. 10, spermatophore. 11, hermaphroditic duct entering albumen gland. 12, ovotestis and hermaphroditic duct. 13,

crop and intestine, dorsal view. 14, buccal capsule, esophagus, and anterior portion of crop, dorsal view; slightly extended; the esophagus curves ventrally as it passes posteriorly to the constriction between the esophagus and crop. 15, portion of crop and intestine, ventral view, showing diverticulum. 16, teeth of radula. 17, jaw.

UROSALPINX CINEREA AND EUPLEURA CAUDATA IN CHESAPEAKE BAY, MARYLAND

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Abbott (1954) states that the Atlantic oyster drill, *Urosalpinx cinerea* (Say), and the thick-lipped drill, *Eupleura caudata* (Say), occur from Nova Scotia to Florida, and from south of Cape Cod to the south half of Florida, respectively. Say (1822) reported *Urosalpinx* from the eastern shore of Maryland and Ingersoll (1881) found this same species in the lower waters of Chesapeake Bay. Winslow (1882) reports in the conclusion an increase in the rough whelk, *Urosalpinx cinerea,* but does not give the specific localities. Engle (1953), when discussing salinity as a limiting factor in the distribution of this species, mentions finding them at Great Rock in Tangier Sound. Information regarding the occurrence of *Eupleura caudata* in Maryland waters of Chesapeake Bay is limited. However, the general distribution of the two species is included in Carriker's review of *Urosalpinx* and *Eupleura* (1955). The same work suggests that soft mud may result in spotty distribution of the drills. The author has observed that both species are able to maintain themselves in large numbers in habitats well removed from oyster beds or other hard surfaces. In such cases they were associated with the wigeon grass, *Ruppia maritima,* and the substratum was soft. Drill cases of both species were found and specimens ranged considerably in size from very young to more than 21 mm. in length.

Beginning in 1951, living specimens of drills have been collected by the author at thirty-two places in Chesapeake Bay, including localities in Pocomoke Sound, Tangier Sound, Little Annemessex River, Big Annemessex River, and Manokin River. Since samplings for other organisms were being made at the time, they were collected with any one of several devices; oyster tongs,

clam rake, clam dredge, oyster dredge, crab scrape, or haul seine, and thus do not represent a quantitative study.

Because of the emphasis currently being placed upon the economic importance of drills and the extensive investigations being carried out to determine adequate control methods, it seems appropriate that additional localities where they are known to occur, should be a matter of record. The findings are tabulated; the symbol X indicating their presence.

The 1957 collections were made while receiving support from the General Research Board of the University of Maryland.

Location	Date	*U. cinerea*	*E. caudata*
Pocomoke Sound			
Marumsco Bar	9/ 9/51	X	
Trevise's Rock	11/ 3/51	X	
Oyster Shell Point	7/13/54	X	
Ape Hole	7/13/54	X	X
Broad Creek	7/13/54	X	
Big Island Bar	7/22/54	X	X
Manhoe Knoll	7/22/54	X	X
Ware Point Bar	7/22/54	X	X
Pocomoke Canal	4/15/55	X	X
Terrapin Lead	8/24/55	X	
East of Ape Hole	7/18/57	X	X
Off R N 4 buoy	7/18/57	X	X
Christy's Oyster Bar	7/18/57	X	X
Little Annemessex River			
Off Stack, James Island	8/ 3/55		X
G Fl 13 buoy	8/ 9/55	X	X
Off Shell Plant, Crisfield	8/ 9/55	X	X
Mouth of River	8/ 9/55	X	
Wk Fl buoy, Broad Creek Canal	8/ 9/55	X	
Front of McCready Memorial Hospital, Crisfield	7/ 3/56	X	
R Fl 3 buoy	7/18/57	X	
Entrance Small Boat Harbor, Crisfield	8/14/57	X	X
Big Annemessex River			
Jones Creek	8/25/56	X	
B C 3 buoy	7/11/57	X	X
Manokin River			
B C 9 REF buoy	9/ 3/55	X	X
R S 6 buoy	7/11/57	X	X
R S 8 buoy	7/11/57	X	X
Tangier Sound			
James Island Light	7/13/55	X	
Off Great Point	7/15/57	X	X
BW Bell buoy	6/10/55	X	
Between R N REF 4 and James	7/31/57	X	X
Island Light	7/31/57	X	
West of Great Point	8/27/57	X	X

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EXTENSIONS OF KNOWN RANGES OF 4 MOLLUSKS

By DEE SAUNDERS DUNDEE and HAROLD A. DUNDEE,
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While collecting in various areas of the U. S. during the past few years, we have found new localities for two introduced species and range extensions for two native species of mollusks. The specimens, which are reported below, are being deposited in the University of Michigan Museum of Zoölogy.

Corbicula fluminea (Müller). Hundreds of specimens of this mollusk were first found in sand piles along an irrigation canal in back of the Desert Plant Botanical Garden (Papago Park) in Phoenix, Maricopa County, Arizona, in June, 1956. Only a few live specimens were taken then (apparently the sand had been dredged from the canal recently), but later Mr. Jack Damman of Arizona State College was kind enough to secure additional living specimens for us. Finding *Corbicula fluminea* here is not surprising even though the canal is about 150 miles from the nearest reported locality. Fitch (1953) discussed its occurrence in canals in Riverside and Imperial Counties, California, and mentioned that the canals are infected all the way back to the Colorado River. As is easy to imagine, these clams might have arrived in Phoenix from the Colorado River via the Gila River as larvae (this is an upstream journey but such was probably made with the aid of man) and eventually into the irrigation system at Phoenix.

The other reported localities at which *C. fluminea* occurs in the United States are in central California (Gregg, 1947) and in

Washington (Burch, 1944). Since this little clam was first observed in this country in 1938, it obviously has spread very rapidly and is becoming a pest in areas where irrigation is required. Doubtless it is more widespread than is realized at present.

Arion circumscriptus Johnston. Several specimens of this slug were taken on January 28, 1952, 6.7 miles east of Boswell, Choctaw County, Oklahoma, on a slope along the railroad right-of-way paralleling U. S. Highway 70 near Muddy Boggy River. The slugs were found in association with *Mesodon inflectus, Bulimulus dealbatus, Polygyra dorfeuilliana,* and *Mesodon thyroidus* in a limestone area where oak, briar, and elm are the predominant vegetation.

Previously known range (Pilsbry, 1948) for this introduced species was British Columbia, Maritime Provinces, Quebec, and Ontario in Canada; Maine, Massachusetts, New York, Pennsylvania, District of Columbia, Michigan, Wisconsin, California, and Indiana (Webb, 1940) in the United States.

Euglandina rosea (Férussac). A single shell was found in a sandy, wooded area 3 miles southeast of Georgetown, Georgetown County, South Carolina, on August 30, 1950. Collecting was done after dark and no others could be located. Time did not permit thorough investigation the following day. The nearest locality is approximately 100 miles southwest on the Beaufort-Hampton County line in Yemassee, South Carolina.

Sonorella coltoniana Pilsbry (?). Numerous specimens, two of which were living, were taken just west of Rimmy Jims by U. S. Highway 66, Coconino County, Arizona, on June 12, 1956. These most closely resemble *S. coltoniana* as described from Oak Creek Canyon (Pilsbry, 1939, p. 337), but they are sufficiently different to warrant the above question mark. All these specimens are characterized by having a double band of pigment on the body whorl. The specimens were found in crevices in rock outcrops along a dry wash in the desert and were difficult to extricate. This is an interesting record in that it is about 50 miles east of the nearest recorded *Sonorella* in the northern part of Arizona and in a non-mountainous area.

Other specimens of interest from the standpoint of means of distribution were *Milax gagates* (Draparnaud). These were not collected but were found in a head of lettuce which was pur-

chased in Clifton, New Jersey. In all likelihood, the lettuce had been shipped from one of the California counties in which this slug occurs.

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INTRODUCTION OF MARISA INTO FLORIDA

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On February 1, 1957, three specimens of a very large freshwater snail were collected in the Coral Gables canal at the westward boundary of the city limits of Coral Gables, Florida. The snail was later identified as the South American *Marisa cornuarietis* (L.) (*Ceratodes* and *Ampullarius* of authors) by Dr. Henry van der Schalie, malacologist at the University of Michigan.

During subsequent months, it became apparent that the initial discovery occurred at the downstream margin of the expanding range of a flourishing snail population which was well established farther upstream. By July, hundreds of snails of all ages were present at the discovery site, and by the end of the summer specimens were found a mile or so farther downstream. At the present time (February, 1958) the snail is abundantly distributed and thriving along about 5 miles of the canal from the semi-brackish zone in the middle of the city westward to the margin of the Everglades. Even at winter water temperatures (56°-72° F.) the population was increasing, for field sampling in late December and January revealed a large number of egg masses and many newly-hatched and juvenile specimens at several points along the canal. These were particularly abundant at the upstream limit of the snail's range, where rooted aquatic vegetation was still thick.

The native range of the species, as given by Baker (1930), is northern South America and southern Central America. In recent years it has been introduced by unknown means into Cuba (Penalver, 1950) and Puerto Rico (Harry and Cumbie, 1956; Oliver-

Gonzalez *et al.*, 1956). As far as the writer has been able to determine by extensive correspondence, this is the only known colony of *Marisa cornuarietis* established in natural waters in the United States.

The method of introduction is not known. However, it almost certainly resulted from the dumping of unwanted *Marisa* which had been used in aquaria. By interviewing nine retailers and two wholesalers of plants and animals used in aquaria, I learned that *Marisa* was introduced into the aquarium trade in the Miami area more than 20 years ago under the trade name "Colombian snail." When its plant-eating proclivities became well known, it lost favor and was finally relegated to the category of undesirable aquarium organisms. The last appearance of the snail in trade channels in Miami was about 1955.

The snail is reported to be a voracious herbivore and in aquaria feeds avidly on *Cabomba, Elodea,* dwarf saggitaria, water cress, carrot, cabbage, lettuce, celery and tomato (Chernin *et al.*, 1956; Michelson and Augustine, 1957). My own observations indicate it feeds on *Naias, Ceratophyllum, Myriophyllum, Cabomba,* filamentous algae and other local aquatic plants. Almost certainly it also feeds on periphyton encrusting the rocks in the canal, since snails are still present by the thousands in a section of canal from which rooted aquatic vegetation has been absent since August, 1957.

Data obtained in natural streams in Puerto Rico and through laboratory rearing and experimentation suggest that under certain conditions *Marisa* can, because of its size and food habits, control populations of other snails (*Australorbis glabratus* and *Biomphalaria pfeifferi*) by competition for food and by destruction of egg masses and young (Chernin *et al.*, 1956; Harry and Cumbie, 1956; Oliver-Gonzalez *et al.*, 1956; Michelson and Augustine, 1957).

My own preliminary experiments indicate that *Marisa* is an exceptionally hardy snail and tolerates environmental conditions usually considered adverse. Specimens have been kept for months in unaerated aquaria where the dissolved oxygen regularly dropped to less than 0.5 ppm. and dissolved carbon dioxide varied from 8 to 19 ppm. They also withstand the effects of starvation very well. Experiments are underway to determine the tolerance limits of the snail to these and other conditions such

as temperature and salinity.

How long *Marisa* has been established in the canal is not known, but probably less than five years. The great abundance of snails and the size composition of the population indicate clearly that the habitat is very satisfactory and the population is expanding.

The canal in which the snail is established connects with others in the great inter-connecting network of drainage canals located in the Everglades south of Lake Okeechobee. Seemingly the species will continue to spread and can be expected to occupy eventually all the canals in South Florida.

The large size of the individual snails (the average Florida adult measures about 1.5 inches in greatest diameter, and many individuals have a maximum diameter of 2.25 inches) and the large number of individuals clearly indicate that a *Marisa* population may have a deleterious effect on the aquatic vegetation in the canals and may radically upset the existing ecological balance in the waterways of South Florida.

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THE CANARY ISLAND HALIOTID

By ROBERT R. TALMADGE

Recently, a series of haliotids was received from Sr. J. F. Guerra Pestano, who had collected the specimens on August 7, 1957, at Santa Cruz de Tenerife, Canary Islands. The specimens arrived in alcohol, with the animals intact within their shells. Prior to this shipment, specimens had been examined from these islands, but in such cases the soft parts were not included. The small lots gave no indication of the basic population. Considerable varia-

tion had been noted in the shells; in some cases separate specific names had been indicated on the data with the specimens. Thus, this sending of an unselected and unsorted lot of both shell and animal furnished an opportunity for a more critical study. The results noted in this comparison are rather interesting and are presented here.

The series consisted of 26 specimens that ranged in shell length from 15 to 54 millimeters. Information indicated that all had been collected at a single locality and on the same date, thus presenting us with a specific population group. Comparisons were made with other Canary Island material as well as specimens from the Mediterranean and the Atlantic Coast of both Europe and Africa.

All the shells of this series fall into the group that is associated as the subgenus *Sanhaliotis* Iredale, 1929, an elongate haliotid, with a somewhat elevated, nearly terminal spire, sculptured with cord-like striae. Considerable variation was found in the shape, cording, and number of open siphonal orifices, so the animals were removed and the sex determined as far as possible, and measurements were made of the shells.

Adult shells appeared to be more depressed, due to the continued growth of the right lip. This made the shell broader than a juvenile, and when erosion wore down the striae, the shell altered in appearance. In juvenile specimens the cavity of the spire was nearly concealed, but in adults this cavity was exposed. This was the only indication noted in which age stages could be coordinated with distinct variations.

Three distinct kinds of cording were noted. Fourteen, the majority of the specimens, had coarse scale-like cording, separated by more rounded thread-like striae. These interspacing striae numbered one to three per major cord, and like the larger sculpturing were also scaled. Under a strong glass, these scales gave the appearance of tile. Ten specimens had a more or less uniform small thread-like series of striae covering the entire dorsal surface. Two specimens had the coarse cords of the majority, but the interspacing areas were free of the finer cords, just smooth shell.

The number of open orifices ranged from 4½ to 7½, with the majority of the specimens falling into the 5 and 6 group. The specimens with over 6 open pores had small, circular orifices, while in specimens with 5 or less the orifices were large and oval.

This combination of age, cording, and orifices created quite a number of variations in this series.

Coloration of the shell varied. Some specimens were nearly concolor, dark red-brown. Others were highly splotched, flamed, and/or maculated with white, pale green, cream, and pink. However, the average shell was the rich red-brown with a few of the lighter maculations, seldom covering over 10 percent. of the dorsal surface.

For all practical purposes, the animal parts were identical, except in 3 specimens. These, two concolor tan and one nearly pure black, were the only noticeable differences in the series. These as noted were only in coloration of the animal parts. Neither sex nor age were noted as a factor in either this coloration, or in shell variations. The animal has the usual fleshy epipodium encircling the muscular foot. The epipodium is the usual double rim, concave between the upper and lower edges, with the rims palmate and processed. The concave area is a mass of papillae on papillae of various sizes. The sole is cream, the pedal a rich brown, and the epipodium blotched in equal-sized squares.

The sex was determined by use of the color of the gonad, and in specimens over 25 mm. in shell length, it could be recognized readily. Under that size, the color of the gonad could not be so used. The series consisted of 8 males, 10 females, and 8 juveniles. Microscopic examination indicated that neither July nor August was the breeding month of this lot. A comparison month by month would soon indicate the breeding season.

Since a number of names have been applied to this species, the writer endeavored to trace all to their original source. By use of descriptions and figures as well as comparisons with definite material, the writer now feels that this is the species to which Reeve gave the locality of Cape Verde Islands in error. Therefore the writer submits the following name.

HALIOTIS (SANHALIOTIS) COCCINEA Reeve

Conchologica Iconica, Vol. III, species 22, Pl. VII, fig. 22, 1846. The description and figure as given by Reeve fits the average specimen from this and other lots. The highly colored specimens fall into what Reeve called *H. zealandica* (a specimen has been compared with the original lot from the Hugh Cumming Collec-

tion in the British Museum). Some malacologists have used the name *H. tuberculata* Linné, and old worn material comes close to that species, but the soft parts fail to match. The use of the name *striata,* both of Reeve and of Linné is more difficult to trace. Again, *striata* Reeve is similar to *H. tuberculata* but the figure represents another of the highly colored small West African races of *tuberculata* which Reeve also referred to as *H. rosacea.* The description of *striata* Linné is difficult to fit into any of the known high-corded elongated haliotids. It may fit any of the Asiatic species, and Linné referred to this species as from Asiatic oceans. Therefore the writer feels that the name *H. coccinea* is the most appropriate for this species.

Summary: H. (*Sanhaliotis*) *coccinea* Reeve is a highly variable species in shell features, yet remains static in animal or soft parts. Probably, due to this variation in shell, a number of names have been applied to this species, which inhabits the Canary Islands of the far eastern Atlantic. A comparison of both shell and animals indicates that these variations are chiefly individual characters, with age creating some variations.

Addenda: Since the above was written, two additional lots arrived from the Canary Islands. Both of these series followed the same pattern as the one referred to in this study. There was one extremely interesting color phase, not noted before. One specimen matched in all details the description and figure of the *H. janus* Reeve. Closer examination revealed that a number of the specimens had traces of this coloration.

MOLLUSKS OF LEBANON CO., PENNSYLVANIA

By ROBERT A. HEILMAN and GORDON K. MacMILLAN

Lebanon County, according to some people is situated in south-central Pennsylvania. Others say it is one of the counties located in the southeastern part of the state. We prefer to ascribe it to southeastern Pennsylvania.

The county is chiefly a fertile valley lying within the Great Valley. It is bounded on the north by the Blue Mountain. On the south it is bounded by the South Mountain. The soils of the county are of Paleozoic age.

The forests and woodlots are chiefly deciduous with no primeval stands remaining. Drainage is provided by the Swatara and

the Tulpehocken Creeks. The Swatara Creek empties into the Susquehanna River, while the Tulpehocken's waters flow into the Schuylkill. Many streams of minor importance connect with these creeks. No natural lakes exist, although there are several artificial lakes.

The mollusks of Lebanon County were partially reported by C. B. Wurtz (1940). In 1948 the senior author presented an expanded list, followed by a supplementary list in 1949. Continued collecting has led to the opinion that a revised list is now warranted. In compiling the present record, the authors have had the help of Dr. Henry van der Schalie and The Rev. H. B. Herrington. The list follows:

Triodopsis tridentata
T. tridentata juxtidens
T. fallax
T. albolabris
T. albolabris dentatus[1]
Mesodon thyroidus
Stenotrema hirsutum
S. hirsutum barbatum[1]
S. fraternum
S. leai[1]
Haplotrema concavum
Ventridens demissus[1]
V. ligera
V. ligera stonei[1]
V. suppressus
V. suppressus virginicus
Zonitoides nitidus
Z. arboreus
Hawaiia minuscula
Retinella carolinensis
Retinella electrina
R. indentata
R. indentata paucilirata
R. rhoadsi
Oxychilus cellarius
Euconulus fulvus
Striatura ferrea
Deroceras laeve
D. reticulatum
Limax maximus
Anguispira alternata
Discus patulus
D. patulus carinatus
D. cronkhitei
D. c. catskillensis
Helicodiscus parallelus
Arion hortensis
Succinea avara
Succinea ovalis
Cionella lubrica
Pupoides albilabris
Gastrocopta armifera
G. armifera clappi[1]
G. contracta
G. pentodon
G. tappaniana
Vertigo ovata
V. pygmaea
V. gouldii
V. tridentata
V. ventricosa[1]
Vallonia costata
V. pulchella
V. excentrica
Strobilops labyrinthica[1]
S. aenea[1]
S. affinis[1]
Carychium exiguum (Say)[1]
Philomycus carolinianus flexuolaris
Pallifera dorsalis
Pseudosuccinea columella
Stagnicola emarginata[2]
S. palustris
S. caperata
Fossaria obrussa

F. obrussa peninsulae
Fossaria exigua
F. modicella
F. modicella rustica
F. parva (Lea)
Helisoma anceps
Helisoma trivolvis[2]
Gyraulus hirsutus
G. parvus
G. circumstriatus
Menetus exacutus[1]
M. dilatatus
Planorbula jenksii[1]
Physa heterostropha
P. gyrina
P. integra[1]
Ferrissia rivularis
Viviparus japonicus
Campeloma decisum
C. integrum[2]
Valvata tricarinata[2]
Amnicola limosa
Ceriphasia virginica
Anculosa carinata
Elliptio complanatus
Anodonta cataracta
Alasmidonta undulata
A. marginata susquehannae
Strophitus rugosus
Lasmigona subviridis[1]
Sphaerium sulcatum
S. striatinum
Musculium transversum[1]
M. partumeium
M. securis
Pisidium dubium[1]
P. compressum
P. casertanum

Two species previously reported have been deleted from this list. They are *Aplexa hypnorum* (L.) and *Amnicola limosa porata* (Say). *Aplexa* does not occur within Lebanon County, nor in surrounding counties. Its inclusion in an earlier list was an error. *A. limosa porata,* if this be a valid subspecies, does not exist in Lebanon County. Specimens previously identified as such are nothing more than obese forms of *A. limosa.*

Because hundreds of field trips had been made over a period of more than ten years, data on collecting stations has been deliberately omitted since they are too extensive for inclusion.

QUICKELLA VERMETA AND SUCCINEA INDIANA

By LESLIE HUBRICHT

QUICKELLA VERMETA (Say)

In 1824, Thomas Say described *Succinea vermeta* (New Harmony Disseminator, 2:230) from the vicinity of New Harmony, Posey Co., Indiana, as follows:

"Succinea vermeta.—Shell suboval, yellowish, very thin and fragile, somewhat diaphanous, with nearly three very oblique volutions; whorls very much rounded, wrinkled; suture very profoundly impressed; spire rather prominent and acute; aperture ovate, the superior termination rounded.

"Inhabits margins of ponds near New Harmony.

1 Rare; found in only one locality, or only one example found.
2 Extirpated.

"This species is remarkable for the very deep indentation of its suture, giving to the whorls of the spire the appearance of being almost separated from resting on each other; and by this character it may be readily distinguished from the other species of this country. It was found by Dr. Troost."

The author found this species at a number of places in the vicinity of New Harmony. Upon dissection it proved to belong to the genus *Quickella,* having a penis similar to that of *Quickella vagans* (Pilsbry).

Succinea vermeta generally has been considered to be a synonym of *Succinea avara* Say. The type of *S. avara* in the Academy of Natural Sciences of Philadelphia is an immature shell and is not identifiable. The type locality is presumed to be Minnesota. There is only one lot of shells labeled *S. avara* from that State in the A.N.S.P. and these appear to be different from the New Harmony shells. Until more is known about the small succineids of Minnesota the identity of *S. avara* cannot be determined. Until the identity of *S. avara* is established, the author proposes that the name *Quickella vermeta* (Say) be applied to the species as typified by the snails found in the vicinity of New Harmony, Indiana.

Quickella vermeta is apparently widely distributed in the midwest, the author having collected it in Indiana, Ohio, Kentucky, Tennessee, and West Virginia.

Succinea indiana Pilsbry.

On May 3, 1958, the author collected *Succinea indiana* Pilsbry at the type locality near New Harmony, Indiana. Upon dissection of the animal it was found to be unrelated to *S. aurea* Lea, in the synonymy of which it was later placed by Pilsbry. Land Moll. N. A. 2:815, 817, figs. 441-i. The penis is similar to that of *Succinea campestris* Say, the mantle is dark gray without the spots characteristic of *S. concordialis* Gould. *Succinea indiana* must, therefore, be considered a distinct species belonging to section *Calcisuccinea* Pilsbry.

The type locality for *Succinea indiana* is the grassy slope of a hill on the farm of Charles Frieg, a little south of, and across the road from the Labyrinth. The loess exposure above, is the type locality for *Pomatiopsis scalaris* F. C. Baker, and since the exposure is a natural one it is probably also the type locality for *Hendersonia occulta* (Say).

MARINES FROM MANUS, ADMIRALTY ISLANDS

By ALAN SOLEM
Chicago Natural History Museum

The only papers dealing specifically with the marine mollusks of the Admiralty Islands are those of Ingram and Kenyon (1945) and McLean and Hebert (1946). A few additional records can be found in Leschke (1912), C. R. Boettger (1916), and the Challenger reports.

While studying more extensive collections from the Solomons and New Hebrides, I identified a small collection made by Dr. Harold W. Harry at Manus Island in October 1944. Of the 92 species, only 31 had been listed by McLean and Hebert (1946). Most of the species are common and widely distributed, but a few significant new records are incorporated. Because the fauna is so poorly known, it has been thought worthwhile to record the entire collection. Species not listed by McLean and Hebert (1946) are preceded by an asterisk (*). For the more unusual species, an authority for identification is cited.

The specimens are deposited in the University of Michigan Museum of Zoology, with a few duplicates in the Chicago Natural History Museum.

**Anadara scapha* Meuschen. *Barbatia bicolorata Dillwyn* (= *fusca* Bruguiere). **B. ovata* Gmelin (= *nivea* Chemnitz). *Hippopus hippopus* Linné. *Fragum fragum* Linné. *Trachycardium flavum* Linné. **Gafrarium pectinatum* Linné. **Venus* (*Periglypta*) *puerpera* Linné. *Mesodesma* (*Atactodea*) *striatum* Lamarck. **Donax* (*Latona*) *cuneatus* Linné. **Cyclotellina remies* Linné. *Tellina staurella* Lamarck. **Corbula modesta* Hinds (Reeve, *Corbula*, pl. II, fig. 14a-b).

Hemitoma tricarinata Born. *Chrysostoma paradoxum* Born. **Euchelus* (*Euchelus*) *atratus* Gmelin. **Thalotia* (*Thalotia*) *elongata* Wood (Man. Conch., 11: pl. 45, fig. 56). *Trochus* (*Trochus*) *maculatus* Linné, form *verrucosus* Gmelin (Kiener, *Trochus*, pl. 109, fig. 4). **Liotia* (*Liotia*) *peronii* Kiener. **Turbo* (*Marmarostoma*) *argyrostomus* Linné. **T.* (*M.*) *chrysostomus* Linné. *T.* (*Turbo*) *petholatus petholatus* Linné.

Angaria delphinus delphinus Linné (= *laciniata Lamarck*). **Phasianella histrio* Reeve (Man. Conch., 10: pl. 37, figs. 34, 35). **Nerita* (*Theliostyla*) *albicilla* Linné. **N.* (*T.*) *patula* Récluz. *N.* (*Ritena*) *plicata* Linné. *N.* (*Amphinerita*) *polita* Linné.

Littorinopsis undulatus Gray. **Modulus tectus* Gmelin. **Cerithium columna* Sowerby. **C. consisum* Hombron and Jacquinot

(= *morus* Lamarck). **C. echinatum* Lamarck. *Liocerithium piperitum* Sowerby.

Rhinoclavus fasciatus Brugière. *R. sinense Gmelin* (= *obeliscus Bruguière*). **Amalthea australis* Quoy and Gaimard (= *conica* Schumacher?). *Canarium* (*Oostrombus*) *gibberulum* Linné. **C.* (*Canarium*) *labiatum* Röding (= *ustulatus plicatus* Lamarck) (see Dodge, 1946: figs. 3, 7). *C.* (*Euprotomus*) *lentiginosum* Linné. *C.* (*Conomurex*) *luhuanum* Linné. *C.* (*Canarium*) *mutabilis* Swainson (= *floridanum* Lamarck) (see Dodge, 1946; figs. 4, 8).

Terebellum terebellum Linné (= *subulatum* Lamarck). **Zebina* (*Morchiella*) *gigantea* Deshayes (H. and A. Adams, Gen. Recent Shells, III: pl. 35, fig. 1). **Z.* (*M.*) *spirata* Sowerby (Man. Conch., 9: pl. 59, fig. 31). **N.* (*N.*) *areolata* Récluz. **N.* (*N.*) *marochiensis lurida* Philippi.

**Polinices flemingianus* Récluz. *P. mammilla* Linné. *P. melanostoma* Gmelin. **Staphylaea staphylaea* Linné. *Colubraria strepta* Crossman (= *distorta* Schubert and Wagner). **C. nitidula* Sowerby (Man. Conch., 3: pl. 14, fig. 130).

**Cymatium gutturnium* Röding. **Gyrineum natator* Röding (= *tuberculatum* Broderip). *Lampusia chlorostoma* Lamarck. **Semicassis* (*Casmarea*) *vibex* Linné. **Chicoreus* (*Chicoreus*) *microphyllus* Lamarck.

**Maculotriton serriale* Leborde and Deshayes (= *bracteatus* Hinds). *Nassa sertum* Brugière (= *francolinus* Brugière). **Pinaxia coronata* Adams (H. and A. Adams, Gen. Recent Shells, III: pl. 14, fig. 1). **Coralliophila cantrainei* Montrouzier. **C. deformis* Lamarck. **Columbella* (*Euplica*) *turturina* Lamarck. **C.* (*Columbella*) *varians* Sowerby. *C.* (*C.*) *versicolor* Sowerby.

**Cantharus fumosus* Dillwyn. **C. gracilis* Reeve (Reeve, *Buccinum,* figs. 96, 97). **C. undosus* Linné. **Engina mendicaria* Linné. **Alectrion* (*Alectrion*) *acuticosta* Montrouzier (Jour. de Conchyl., 12: pl. 10, fig. 8). **A.* (*Zeuxis*) *lentiginosus* Adams (Reeve, *Nassa,* pl. III, fig. 15). **A.* (*Z.*) *sertula* Adams (Man. Conch., 4: pl. 10, fig. 16).

**Arcularia globosa* Quoy and Gaimard (Reeve, *Nassa,* pl. X, fig. 62). **A. granifera* Kiener (Man. Conch., 4: pl. 8, figs. 39-41). **Hebra muricata* Quoy and Gaimard (Reeve, *Nassa,* pl. XI, fig. 73). **H. subspinosa* Lamarck (Kiener, *Buccinum,* pl. 26, fig. 103). **Hima paupera* Gould (Man. Conch., 4: pl. 15, fig. 246).

**Nassaria coronata* Brugière. **N. crassa* Koch. **Niothia albescens* Dunker. **Pusia discolorea* Reeve (Man. Conch., 4: pl. 55, fig. 580). **Scabricula* (*Chrysame*) *adusta* Lamarck. *Vasum turbinellum* Linné.

**Clavatula unizonalis* Lamarck. **Crassispira bijubata* Reeve. *Turris babylonia* Linné. **T. cingulifera* Lamarck. **T. picturata* Weinkauff. **Conus arenatus* Bruguière. **C. ceylonensis sponsalis*

Gmelin. *C. coronatus* Gmelin (= *miliaris* Brugière).

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PHIL LEWIS MARSH
1891-1957

The death of Dr. Marsh (plate 7) on October 12, 1957, was a serious loss to American malacology and the many fields to which he contributed. Phil was born in Tombstone, Arizona, on February 4, 1891. His father was E. O. Marsh, a teacher, a Greek scholar, and a collector of good books, which fascinated Phil and furthered his interest in literature. These had much to do with his strong convictions that the professional man should have a well rounded education, not only for development of skill, but also for personal satisfaction. Books about great philosophers helped Phil formulate a sound concept of life, which did not place science and religion in conflict. In the years ahead, he was to help perplexed students and scientists to formulate their own beliefs.

Upon graduation from the University of Michigan (A.B.) in 1911, Phil entered the Medical School. But he enlisted on December 14, 1917, in World War I. As a member of the Medical Corps, he served until July 13, 1919, on the Alsace front, Chateau Thierry and Fismus offensive, and in Jurigny, Mt. Fancon, Barrtheville and Haramont actions. After his return to Michigan, he was granted his M.D. in 1919 and M.A. in 1923.

Following his internship, he was appointed to the staff of the Medical School, and served in Internal Medicine, as instructor from 1921 and assistant professor from 1924 to 1926. During these years, he was associated with Dr. L. R. Newburgh in many research projects, and together they developed the high fat diet for treatment of diabetes mellitus, before the discovery of insulin. Since he knew this diabetes was hereditary, he grappled with the problem of increasing the life of young diabetics until they might

produce children, some of whom would also be diabetics—an unsolved problem to date.

Later he practiced internal medicine in Detroit for 10 years, and was a part-time consultant for the Chrysler Motor Company. He was made a member of Sigma Xi in 1922, a charter member of the Detroit Academy of Sciences in 1929, and joined the American Malacological Union in Ann Arbor in 1937.

His interest in collecting shells undoubtedly was fostered by the years he spent on Muskinosa, an isle which belonged to his family, off of Drummond Island. After 1935, when he collected marine shells in California, Phil's interest in mollusks, his knowledge of systematics and his zeal for collecting developed with characteristic rapidity. In 1936, the collections of the late Bryant Walker moved to Ann Arbor. Calvin Goodrich, then Curator of Mollusks, solicited Phil's assistance, to work with our small group in cataloguing the 100,000 lots in the Walker collections. In 1938, he was appointed Honorary Associate Curator of Mollusks, a position which he held for almost 20 years.

One of his major interests was the distribution of land mollusks in Michigan. His studies led to a publication on the *Stenotrema monodon* group (Naut. *54*:113-116, 1941), in which he carefully delimited the ranges of the two species and one form as they occur in this state. But he keenly appreciated that the patterns revealed by the detailed maps of all the Michigan species were inaccurate, because only the regions around active centers were represented reasonably well in collections. Consequently, Phil worked intensively to fill in the gaps in the neglected areas. Plans are under way to publish his data posthumously.

Early in 1940, Phil joined Alan Archer on a collecting trip into southeastern states. After a few days in Florida with the late Dr. Bales, the McGintys and the Kotos, they explored the southern Piedmont eastward to near Augusta, Georgia. In August, 1941, Phil accompanied Goodrich on a collecting trip into the Rocky Mountains, and proved that *Zoögenetes harpa* (Say) did occur there. (Naut. *55*:97-98, 1942).

Phil's hobbies included travel, gardening, fishing, writing limericks, concocting puzzles, cooking and just visiting with people.

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1 Mrs. Marsh kindly supplied interesting and pertinent information for this article.

When he married Ola Gladys Hylton,[1] a doctor in Public Health, who also had been associated with the University of Michigan, they combined their mutual interests. From their home in Ann Arbor, they collected extensively in Washtenaw County, and helped greatly to make it the most thoroughly collected in the Great Lakes region.—Henry van der Schalie.

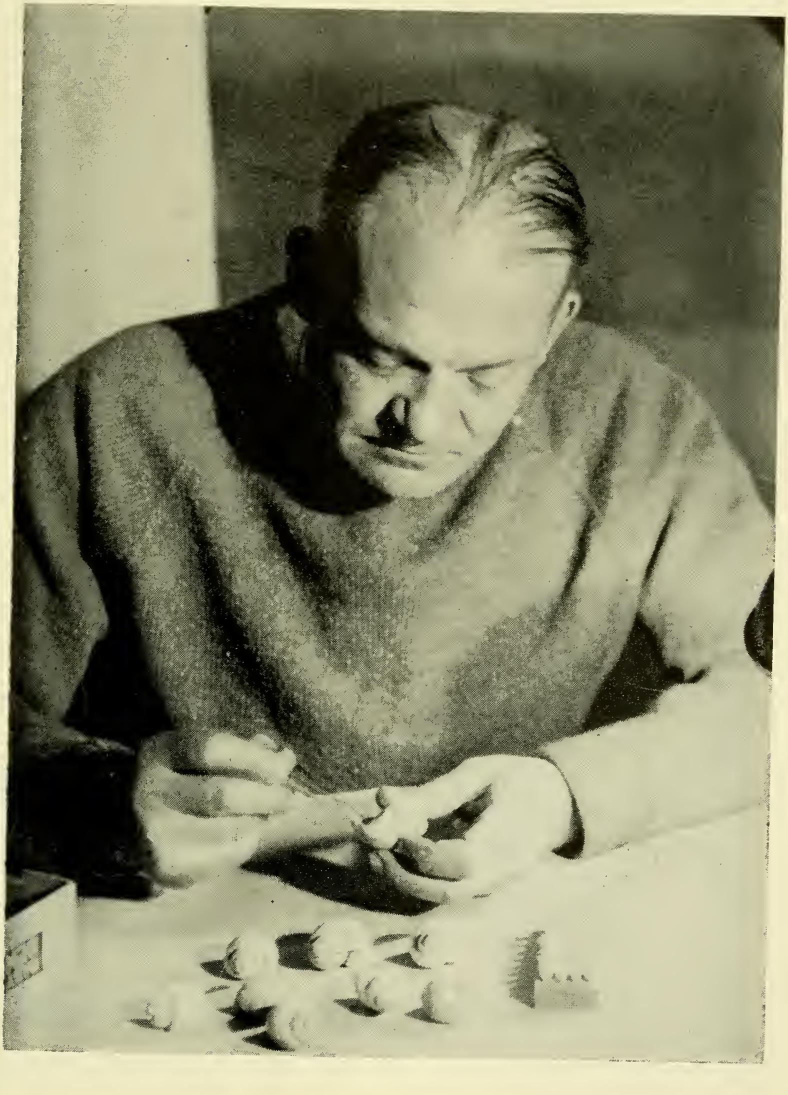
AMERICAN MALACOLOGICAL UNION 24th ANNUAL MEETING, SEPT. 2-6, 1958

After an absence of 21 years, the A. M. U. returned to the University of Michigan, Ann Arbor, Michigan, for a four-day meeting, September 2 to 6, 1958. The 65 registered guests enjoyed the hospitality of the university, which provided bedrooms, excellent meals, meeting room and a comfortable lounge, all in the spacious and modern South Quadrangle Dormitory.

Added features provided by Dr. Henry van der Schalie and his helpful staff were a visit to the University Museum and a bus tour of the campus.

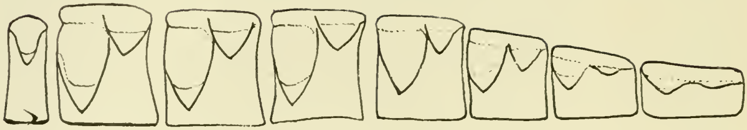
Dr. Aurèle LaRocque, President of the Union, presided over the lecture sessions, during which the following papers were read:

"Small beginnings" by Adlai B. Wheel, Sr. "Distribution and color patterns of *Cepaea hortensis* at Cape Ann, Massachusetts" by Ralph W. Dexter. "Results of the Puritan-American-Museum Expedition to western Mexico" by William K. Emerson. "Preliminary report on abyssal Atlantic mollusks from the Theta and Vema expeditions" by Arthur H. Clarke, Jr. "*Cypraea mus* needs attention" by Crawford N. Cate. "A monograph that needs to be published" (read for) Morris K. Jacobson. "Julia Ellen Rogers" by Crawford W. Cate. "Pleistocene molluscan faunas of the Humboldt site, Ross County, Ohio" (read for) Martin B. Reynolds. "Pleistocene molluscan faunas of the Newell Lake deposit, Logan County, Ohio" by James A. Zimmerman. "Methods of studying Pleistocene non-marine Mollusca" by Aurèle LaRocque. "Chromosomes of basommatophoric pulmonates" by John B. Burch. "Evolution of predator-prey relationships in snail-killing sciomyzid larvae (Diptera)" by C. O. Berg, B. A. Foote and S. E. Neff. "Preliminary tests of the ability of sciomyzid larvae (Diptera) to destroy snails of medical importance" by S. E. Neff and C. O.

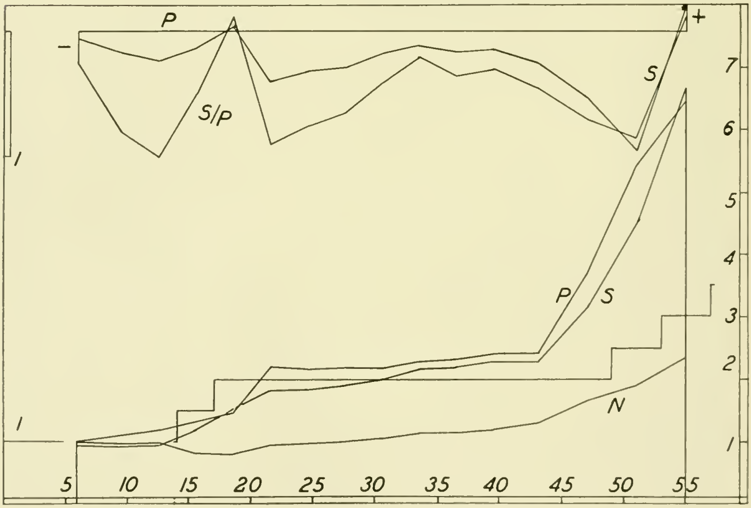


PHILIP LEWIS MARSH

1891-1957



Radula of *Hypselostoma insularum* Pilsbry



NAUTILUS finances. N, no. of subscribers. P, printing cost. S, subscription income. S/P, in %. Nos. at bottom give years, 1905-55; those at right, multiples of N, S & P of vols. 18-21 (Scale of upper S × 2 and S/P × 10). Steps above 15 and 50-55 show price increases.

Berg. "The morphology of *Lymnaea emarginata* Say, with remarks on problems relating to the systematics of lymnaeids" by Harold J. Walter. "*Gundlachia* in Michigan" by Paul F. Basch. "The egg-laying habits of *Pomatiopsis lapidaria* and *P. cincinnatiensis*; problems relating to the culture of schistosome intermediate hosts" by Henry van der Schalie and Dee S. Dundee. "Remarks on *Carychium stygium*" by Leslie Hubricht. "Remarks on the Sphaeriidae" by H. B. Herrington. "A pleurocerid index to past collecting in the Ohio and Tennessee River basins with some thoughts for the future" by Joseph E. Rosewater. "A study of the Ancylidae" by Paul F. Basch. "Further study of the salt marsh snails" by Joseph P. E. Morrison. "Brackish water genera of Mactridae" by Joseph P. E. Morrison.

One session was devoted to the memory of the late Dr. Henry A. Pilsbry, with reminiscences by his colleagues and friends. It was opened by H. B. Baker: "An appreciation of Dr. Pilsbry's scientific contributions." Several others spoke with feeling of their associations with the first president of the A. M. U.

Following the annual dinner on Thursday night, delegates and their guests were entertained by a series of slides together with the running comments of Dr. Elmer G. Berry. The beautiful scenes, taken as he and Mrs. Berry traveled about Africa under the auspices of the World Health Organization, were interspersed with those which illustrated the seriousness of the snail-spread, mainly tropical diseases of schistosomiasis.

On the final day, a field trip was made, which combined stops at good collecting spots for land and freshwater species with a box lunch at the final destination, the University of Michigan biological field station known as the George Reserve, some 18 miles northwest of Ann Arbor.

The following officers were elected to serve in 1958-1959:

President, R. Tucker Abbott. Vice President, Katherine Van Winkle Palmer. Second vice president, John E. Fitch. Secretary-Treasurer, Margaret C. Teskey. Publications Editor, George M. Moore. Councillors-at-large, John Q. Burch, Ruth A. Craine, Leslie Hubricht and Thomas E. Pulley. Elected to honorary life membership, H. Burrington Baker and Joseph C. Bequaert.

The 1959 meeting will be held next June in and/or near Philadelphia, where the host organization will be the Philadelphia

Shell Club, which is already hard at work to insure that the 25th annual meeting shall be unusually fine.—MARGARET C. TESKEY, Secretary, P. O. Box 238, Marinette, Wisconsin.

NOTES AND NEWS

RADULA OF HYPSELOSTOMA INSULARUM.—*H. insularum* was described by Dr. H. A. Pilsbry from Yonakunijima, one of the Ryukyu chain, in 1908. Fortunately I have received several specimens of this species, collected from the same island by Mr. Tetsuo Amano, through Dr. Tokubei Kuroda. *Hypselostoma* is hardly distinct from *Boysidia* in its radular features, which are as follows:

Transverse row with 23 teeth, of which 4 are laterals and 7 are marginals. Central tooth (at left in pl. 8, upper figure) unicuspid, narrow, about half width of the laterals, which are bicuspid, with large, square, basal plates; larger inner cusp somewhat crowded over by smaller outer one. Marginals 9 (inner 3 shown at right of fig.) low and wide, with more reduced cusps toward the outer end of the row. Cf. T. Habe, 1958, Venus *19:* pp. 109-117.

TADASHIGE HABE, Amakusa Marine Bioligical Laboratory, Kyushu, Japan.

QUICKELLA VAGANS (Pilsbry). Dr. John M. Teal recently sent us a fine series of this species collected from behind the sand dunes on Sapelo Island, Georgia. This record extends the southern range of this species considerably, the prior record being Lake Waccamaw, Columbus Co., North Carolina.—W. J. CLENCH

PHYSA COMPACTA Pease. During a trip to the Orient, Dr. N. L. H. Krauss collected a small series of freshwater shells at Sha Tin, New Territories, Hong Kong, China. In this series, there were several specimens of *Physa compacta* Pease, a species heretofore known only from the Hawaiian Islands. There are no known endemic members of the Physidae from southern Asia, at least east of India and south of Siberia. This record seems worthy of note as this aquatic species may spread over a large area in time on ornamental or edible freshwater plants.—W. J. CLENCH

THE FAMILY STENACMIDAE.—Attention should be drawn to the close similarity of *Habea inazawai* Kuroda from Japan (Jap. Journ. Malac. ["Venus"], *13:* 11-14, fig. 1; Habe, *ibid.,* pp. 65-67,

figs. 1-6, both 1943) to *Stenacme floridana* Pilsbry of Florida (Naut., *58:* 112-116, pl. 5, 1945). Copies of the former publication did not reach the United States until long after the end of the war. *Habea* Kuroda, 1943, was placed in the family Epitoniidae (or "Scalidae"), which are at present considered prosobranchs. *Stenacme* Pilsbry, 1945, was placed in the pulmonate superfamily Amphibolacea and in a "new" family, the Stenacmidae. The descriptions and illustrations of the two species show clearly that they are almost certainly congeneric. The shell, operculum, radula, egg capsule and shape of the foot are virtually identical. In both, the side of the foot extends up over part of the shell on each side. There are slight differences in the shell. Therefore, we conclude that the Floridian species should be known as *Habea floridana* (Pilsbry).

On ecologic grounds, a marine amphibolacean would be improbable. Species in the Amphibolidae live in fresh or brackish water and are known from New Zealand, Australia, the East Indies, Japan, China, India and South Africa. The placement of *Habea* in the Epitoniidae by Kuroda appears to be correct, for the radula is ptenoglossate and the egg capsules show similarities to those of *Epitonium turtonae* (Turton) [*"Scala turtonis"*] as figured by Thorson (Medd. Komm. f. Danmarks Fiskeri— og Havunders., Plankton, 4 (1): 194, 1946). The smooth shell of *Habea* makes it a somewhat aberrant member of the family. In shell characters, it shows affinities with the Janthinidae, an allied family, all species of which are pelagic. The Japanese species is semi-parasitic on a sea anemone, *Aiptasiomorpha luciae* (Verrill), which is an almost cosmopolitan species. It also occurs at Beaufort, North Carolina, and Port Aransas, Texas, as well as on the Pacific coasts of Asia and North America, as stated by J. W. Hedgpeth, in Fish. Bull. *89,* Fish and Wildlife Service, pp. 285-290, 1954. The anemone may be present also in Florida. Both snails live intertidally on beaches of pebbles and rocks. Some species of *Epitonium* are also parasitic.—Robert Robertson and Katura Oyama.

Fulgoraria kaneko Hirase.

Fulgoraria kaneko Hirase, 1922. Illustrations of a Thousand Shells, Vol. 4, fig. 319 (no locality given). Jan. 15, 1922.

Fulgoraria kaneko Kuroda and Habe, 1950. Illustrated Cata-

logue of Japanese Shells, Vol. 1, no. 5, p. 31, pl. 5, fig. 9; pl. 6, fig. 2, (Kyoto, Japan).

Description: Shell reaching 110 mm. (about 4½ inches) in length, fusiform and costate. Color a dull and light reddish brown. Aperture elliptical in outline. Suture slightly indented. Outer lip thin. Columella oblique and supporting 5 well developed plicae. Nuclear whorls 2½ and smooth, remaining whorls sculptured with numerous and broad, axial costae (11 on the ultimate whorl). Microscopic sculpture consists of very fine spiral threads, which produce a reticulate pattern where the spiral threads cross the axial growth lines. Length 110, width 38 mm. neoholotype.

Kuroda and Habe redescribed this species, using the same name, in the "Illustrated Catalogue of Japanese Shells," 1950, Vol. 1, No. 5, p. 31.

According to the International Rules, a figured specimen with a name is legally "described" even though no descriptive text is associated with such a figure. To illustrate this point, consider the many figures of Lamarck published in the "Liste, Encyclopédie et Méthodique" in 1816 which refer to figures only. The text descriptions did not appear until many years later though the various names of the species date from 1816. There are, of course, many other examples.

Kuroda and Habe created a neotype because Hirase's original specimen was destroyed during the recent war. This is permissible if no known primary types exist, but in this case we possess one of Hirase's paratypes. This specimen, Museum of Comparative Zoology no. 43699, becomes a neoholotype with the type locality, Korea Strait, Japan. There is an additional paratype in the United States National Museum no. 343918 from the same locality and also received originally from Y. Hirase.

The four volume set of Hirase's "Illustrations of a Thousand Shells" was an attempt not only to illustrate the many species of the land, freshwater and marine mollusks of Japan but also to express the artistry of fine Japanese woodcuts which had reached a high degree of development in Kyoto. The four volumes appeared between 1914 and 1922.—William J. Clench.

The Nautilus finances.—As proof of the statements made in the history of the Pilsbry Nautilus (vol. 71, p. 112), 6 unsmoothed "curves" are presented (pl. 8, lower fig.). The scale along the bottom represents years (1905-1955) while the vertical

one at the right shows multiples (1-7) of the yearly (volume) costs of printing (P) and receipts from subscriptions (S) during volumes 18 to 21 (P equals $200). Also these are multiples of the number (190) of paid subscriptions (N) during the same period. The steps around 1915 and at the right represent the increases in price from $1.00 a year to $3.50. These steps also show the intervals plotted (at the mid-points): 3 volumes from vols. 18-54, and 4 vols. from 55-71 (1941-57). Near the top of the figure, the differences between costs of printing (P) and paid subscriptions in the same units (S) and in percentages (S/P) are plotted. The vertical scale (shown at left) of the upper S is twice that of the lower curves, while that of S/P (1 marks 20%) is 10 times as great.

The increases of P and necessarily of S (N times price) during the two world wars and the accompanying inflations are very marked. The loss of foreign subscribers around 1915-20 also is noticeable, but that before 1943 (the sharp break in N?) is masked by the increase in the U. S. subscriptions. Expressed in dollars, the effects of the last world war seem much greater than those of the older one, but the percentages of increase (not shown) and of the differences (S/P) are as great or greater during the earlier war. For example, the greatest percentage increase occurred between 1920 and 1923, and the total increase around the older war was 2.2 times, and was 2.4 times for all the recent years. Also, the price of the NAUTILUS was doubled by the older war and has increased only 1½ times between 1949 and 1957. Similarly, the percentage differences (S/P) between S and P drop lower either side of the 1918 peak than they do around 1951.

Whether P and S will level off in future years, as they did between 1922 and 1943, remains to be seen. The NAUTILUS points with pride to the fact that the only times when the receipts from subscriptions (S) have exceeded slightly the bare costs of printing (postage and envelopes not included in P) were short periods around 1918 and at the present time, just after increases in price. Of course, since the NAUTILUS has no endowment, the gaps between total costs (12% more than P in vol. 70) and incomes from subscriptions (S) have been bridged mainly by the sales of back numbers.

A general conclusion may interest those bored by financial sta-

tistics. Relatively, the number of subscribers has not increased significantly (about 4%) more than has the population of the U. S., and probably less than have the people of the world. When one considers the rapid increase in hobbyists during recent years, enthusiasm for the science of malacology evidently has diminished proportionately during the first half of the century, and this may apply to basic science as a whole. Have we passed the peak of our civilization?—H. Burrington Baker.

PUBLICATIONS RECEIVED

Pacific sea shells. By Spencer Wilkie Tinker. 230 pp. and Index. Plates on every other page. Revised Edition pub. by Chas. E. Tuttle Co., Rutland, Vermont. Printed in Japan. $3.25. 1958.—Included in this new printing are the common gastropods and a few chitons, tooth shells, and cephalopods of Hawaii, and the South Seas. Description of each species is for the most part opposite to its illustration, a great help to beginning shell collectors, and both common and scientific names are given. Unfortunately Mr. Tinker follows the old French habit, which perhaps is more correct morphologically, of figuring shells with the apexes downward. Because of uniformly dark background, some dark colored shells are completely unidentifiable from plate. However, this handbook surely will be very useful to the novice.—B. B. B.

Fossil land shells from western Pacific atolls. By Harry S. Ladd. J. of Paleont. 32:183-198, pl. 30. 1958.—Four new species (3 named) of fossil ptychodons from the Ellice and Marshall Islands are described and figured. But do endodonts have a "female" (p. 192)?—H. B. B.

The family Succineidae in Kansas. By Charles D. Miles. Univ. Kas. Sci. Bull. *38*, pt. 2 (24) :1499-1543, incl. 4 pls. 1958.—This studies the 7 known spp. Good descriptions and figures of shells and genitalia are included. Incidentally, is not the lateral penial lobe in *Quickella* a diverticulum rather than a terminal "appendix," as it usually has been called?—H. B. B.

Materiais para o estudo da fauna malacologica de Mocambique. By J. M. Braga. Publ. Inst. Zool. "Dr. Augusto Nobre," no.

50, 67 pp., 14 pls. 1956. This is a report on a collection of mainly marine, with a few inland mollusks obtained by the Zoological Mission of Mozambique, Africa. Photographs of over 100 marine shells are given.—H. B. B.

Systematic studies on the non-marine Mollusca of the Indo-Austrian archipelago. V. Critical revision of the Javanese freshwater gastropods. By W. S. S. van Benthem Jutting. Treubia 23 (2): 259-477. 135 text — figs. 1956.—The valuable paper collates keys and descriptions of all the groups. The clear figures show the shells of most species and the radulae of many. Habitat and distribution notes and synonymies of the species are given.—H. B. B.

Mollusques terrestres et fluviatiles de l'archipel Neo-Caledonien. By André Franc. Mém. Mus. Nat. Hist. Nat., série A, tome 13. 200 pp. and 24 pls. 1956—This is an excellent compilation of the known inland species from New Caledonia, with fine new figures of the majority, including many type shells. It should be of great help to future collectors. Above the species level, little systematic contribution is attempted; the arrangement mainly follows Thiele, but with mechanical promotion of some groups to generic rank. In the Helicarionidae, for example, no species of *Microcystis* (Austral and Cook Islands) would be expected so far west; three of those listed as such possibly are Sesarinae near *Orpiella*; but the other might be a *Lamprocystis* (Microcystinae). The figure of *"Kaliella" subfulva* looks like a *Liardetia.—H. B. B.*

THE NAUTILUS

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VARIABILITY OF SHELL IN APLYSIA CALIFORNICA

By LINDSAY R. WINKLER[1]

Allan Hancock Foundation,[2] University of California, Los Angeles 7

In the west coast sea hare, the shell is almost or completely hidden by the shell-forming organ or mantle, which in turn, is covered by the folds of the parapodial lobes. The aplysiid shell is a broad, shield-shaped, chitinous structure resembling the half of a bivalve shell. In some species it possesses a thin calcareous lining.

In even small specimens of *Aplysia californica* Cooper, the mantle has completely covered the shell and the aperture has all but closed. The mantle margin is united into a minute tube on the dorsal surface of the shell. The apex of the shell is attached at a point to the left of the excurrent siphon.

Pilsbry (1895, p. 67) noted the undesirability of the aplysiid shell as a basis for classification in these words: "So many species are . . . described merely from the least characteristic organ—the shell—that any attempt at arrangement . . . will doubtless be subject to much revision in the future." The writer first noted the variation of the shell when describing *A. vaccaria* (Winkler, 1955) and included photographs of the shell to illustrate the variation. In the present paper, the intra-specific variation of the shell is further reiterated.

Materials and Methods: Shells were obtained from the sizeable collection of specimens of *A. californica* deposited in the Allan Hancock Foundation, University of Southern California. These were supplemented by many shells taken during the process of other aplysiid investigations. The shells were taken from 70% alcohol, laid on wet 3 x 5 cards and traced around. These tracings became the basis for the sketches herewith presented.

[1] Present address: School of Tropical and Preventive Medicine, Loma Linda, California.

[2] Allan Hancock Foundation Contribution Number 231.

Observations: In shells of *Aplysia californica,* the normal change in structure becomes apparent when shells of specimens of different size ranges are arranged side by side. The shell from a 2 to 3 inch specimen is flat and elongately shield-shaped (Pl. 9, fig i). As the animal grows to five or six inches, the shell assumes the hatchet-shaped form of the adult specimen as described by Cooper (1863) (fig. c). Unfortunately, because of the size of the adult animal and because the young are often much more abundant than larger animals, the young animals form the bulk of the specimens in most collections. The result is that most shells available for study are juvenile shells, not necessarily typical of the adults of the species.

After the first year, the animals begin to thicken their shells with a chitinous material. *A. californica* normally does not have a calcareous layer as do some others; however, in the young the writer has occassionally observed specimens having weak calcareous layers. These juveniles had a high percentage of coralline algae in their fecal pellets which indicated a diet high in calcium. This may have resulted in excess calcium being deposited as the calcareous layer not normally present in the species.

Many shell anomalies have been noted. Among them are those illustrated in plate 9. Fig. e shows a complete shell, but all embryonic stages through the third are in an abnormal position. In spite of this, the neaplysiid attachment plate, normally built in the plane of the nucleus, is present with both the embryonic nucleus and the final shell resembling the normal in other respects. Fig. d shows an abnormal shell in which the nucleus was not present.

As the sea hare grows older, a chitin-like material is often laid down in heavy ridges and, in some other species, as mentioned by Cooper (1863), produces an apparent compounding of shells. This has not been observed, however, in *A. californica.*

Discussion: As the writer has shown (Winkler, 1958), the larval shell develops through a gastropod stage and finally opens out into a spoon-shaped, covering shell which later develops into the characteristic organic shell of the adult. This shell, which was important for the protection of the larval and post-larval animal, becomes vestigial after metamorphosis and would seem

to have little or no further bearing on survival. Such a shell appears to have little further care exercised in its construction and becomes very variable.

This has a practical bearing on specific studies on aplysiids in emphasizing that the shell in itself is a very unreliable criterion on which to base a new species.

Summary

The normal shell of *A. californica* shows variability from elongatedly shield-shaped to broadly hatchet-shaped. This is the normal progression in shell shape as the sea hare grows to adulthood. Shell anomalies occur which apparently do not affect the future of the individual.

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CLASSIFICATION AND RADULA OF MITROMORPHA ATRAMENTOSA

By VIRGINIA ORR

The small cone-like snail, *Mitromorpha atramentosa* (Reeve) (*Gastropoda: Turridae*), found in the littoral waters of the Indo-Pacific from Hawaii to Zanzibar, has been placed by various workers into three families, *Conidae, Columbellidae* and *Turridae.* The confusion in its classification was largely due to ignorance of its soft parts, especially its radula, and to a combination of shell characters common to several groups.

In February, 1957, a living specimen was collected on the outer reef at Kiwengwa, Zanzibar, by the Natural Science Foundation-Academy of Natural Sciences of Philadelphia expedition. The radula of this animal was compared with that of *M. filosa* (Carpenter), type of the genus *Mitromorpha* Carpenter, to which *atramentosa* was assigned by Thiele (1929) and Wenz (1943). Radulae and shells compared are in the collection of the Academy of Natural Sciences of Philadelphia.

MITROMORPHA Carpenter 1865.

Type: by monotypy, *Daphnella filosa* Carpenter 1864. Range: Eocene-West Indies, Pliocene-Europe. Recent: Atlantic and Pacific America and Indo-Pacific.

Shell biconic, small; posterior siphonal notch inconspicuous; columella smooth; small denticles inside outer lip.

MITROMORPHA (LOVELLONA) ATRAMENTOSA (Reeve)

Conus atramentosus Reeve. 1849. Conch. Icon. v. 1, sp. 315.

Conus atramentosus Reeve. Weinkauff 1875. Conch. Cab. v. 4 (2) p. 382.

Conus (Conella) atramentosus (Reeve) Tryon. 1884. Manual of Conch. v. 6, p. 85.

Conorbis atramentosa (Reeve) [*Columbellidae*] Pace. 1902. Proc. Mal. Soc. Lon. v. 5, pp. 43, 56.

Columbella (*Conidea*) *atramentosa* (Reeve) Schepman. 1911. Siboga Rep. v. 2, p. 338.

Lovellona atramentosa (Reeve) [*Turridae*] Iredale. 1917. Proc. Mal. Soc. Lon. v. 12, pp. 329.

Mitromorpha (Lovellona) atramentosa (Reeve) Thiele. 1929. Handbuch System. Weicht. v. 2, p. 366.

Mitromorpha (Lorellona) [sic] *atramentosa* (Reeve) Wenz. 1943. Handbuch Palaozoologie, v. 6, p. 1428.

Type locality: Island of Mindoro, Philippines. Range: littoral Indo-Pacific, Hawaii to Zanzibar.

The combination of cone-shape, straight smooth columella, small denticles inside the outer lip and lack of a turrid sinus, found in the shell of *M. atramentosa* proved puzzling to many authors. Many, including Weinkauff (1875) and Tryon (1884), considered it an ally of the West Indian "*Conus*" *dormitor* Sowerby and put it in the conid subgenus *Conorbis* Swainson or in *Conella* Swainson. But Pace, in 1902, after a study which included the type lot of *atramentosa*, decided that this group was not *Conidae*. He put *Conorbis*, including *atramentosa* and *dormitor* in the buccinid family *Columbellidae*. These changes of classification were made with little or no discussion of the reasons therefor, and were apparently based solely on shell characters.

Meanwhile, Dall (1889, pp. 164-165) studying some related American material, relegated the West Indian *dormitor* and allied species to the eastern Pacific genus "*Mitromorpha* A. Ads." (*Pleurotomaridae*). He did not mention the Indo-Pacific species in his paper. In 1917, Iredale showed that Carpenter, not A.

Ads., was the author of *Mitromorpha* and the type species was the Eastern Pacific, *filosa* not *gracilis* Carpenter as had been previously supposed. Concerned with the position of the Indo-Pacific members of the group, he created a new turrid genus *Lovellona,* type *atramentosa,* without giving his reasons for so doing. Since then, Thiele (1929) and Wenz (1943) have reduced *Lovellona* to a section or subgenus of *Mitromorpha.* None of these authors gave references to the radula or soft parts of either *atramentosa* or *filosa* so it is assumed these conclusions on their affiliations were drawn from shell characters alone.

This makes the comparison of the radulae of these species interesting for the radula is particularly valuable in indicating superspecific relationship.

The radula of *M. atramentosa* is toxoglossate. Its shaft-like teeth and radula formula, 1: 0: 0: 0: 1, exclude the species from the rachiglossate family *Columbellidae,* 0: 1: 1: 1: 0. Its teeth show considerable resemblance to the *Mitromorpha* genotype, *M. filosa* (figs. 1 and 2). They are simple, without barbed tips, serrate shafts, or knobbed bases characteristic of many groups of *Conus* (Peile, 1939) or complexly folded and barbed as in *Conorbis* (Thiele, 1929, p. 372). Minor differences, such as the larger base and slightly stockier form of *atramentosa* teeth, do not in themselves warrant generic recognition.

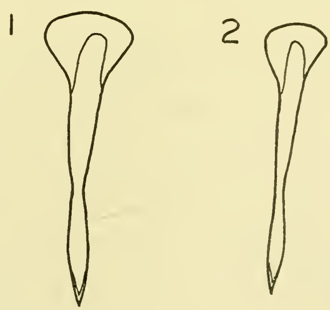

Fig. 1. Single tooth from the radula of *Mitromorpha atramentosa* (Reeve). Outer reef at Kiwengwa, Zanzibar. (Natural Science Foundation), ANSP. 212283. Fig. 2. Single tooth from the radula of *Mitromorpha filosa* (Carpenter). San Pedroa Bay, California. (I. S. Oldroyd) ANSP. 114438.

The radula of *M. atramentosa* is confirming evidence that the species is correctly placed in the genus *Mitromorpha* (*Turridae*).

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MARINE SHELLS OF MIDDLETON ISLAND, ALASKA

By G. DALLAS HANNA and LEO GEORGE HERTLEIN

Middleton Island is located in the Gulf of Alaska, about 80 miles south of Cordova. It has been visited very infrequently in the past because of poor landing facilities. In June, 1956, Norman Wilimovsky, John Thomas and Robert Rausch investigated the natural history of the island to determine, in so far as possible, the species of animals and plants which have become established there. Modifications of the surface features are expected to result from large scale activities in the future.*

The 1956 party assembled a small collection of mollusks which has been submitted to the California Academy of Sciences for identification. Twenty-one species are present in the lot and also one barnacle. To these may be added for reference purposes, two additional species cited by Dall (1921, pp. 32, 107) from Middleton Island. Thus the known marine mollusks from this island consist of 5 pelecypods, 14 gastropods, 3 chitons, 1 cephalopod and one barnacle. All, with one possible exception, are known to occur in waters of this general region at the present time. However, this one, *Littorina arctica,* may have been cited in Alaskan literature under a different name.

* These studies were aided by a contract between the Office of Naval Research, Department of the Navy, and the Arctic Institute of North America. Reproduction in whole or in part is permitted for any purpose of the United States Government.

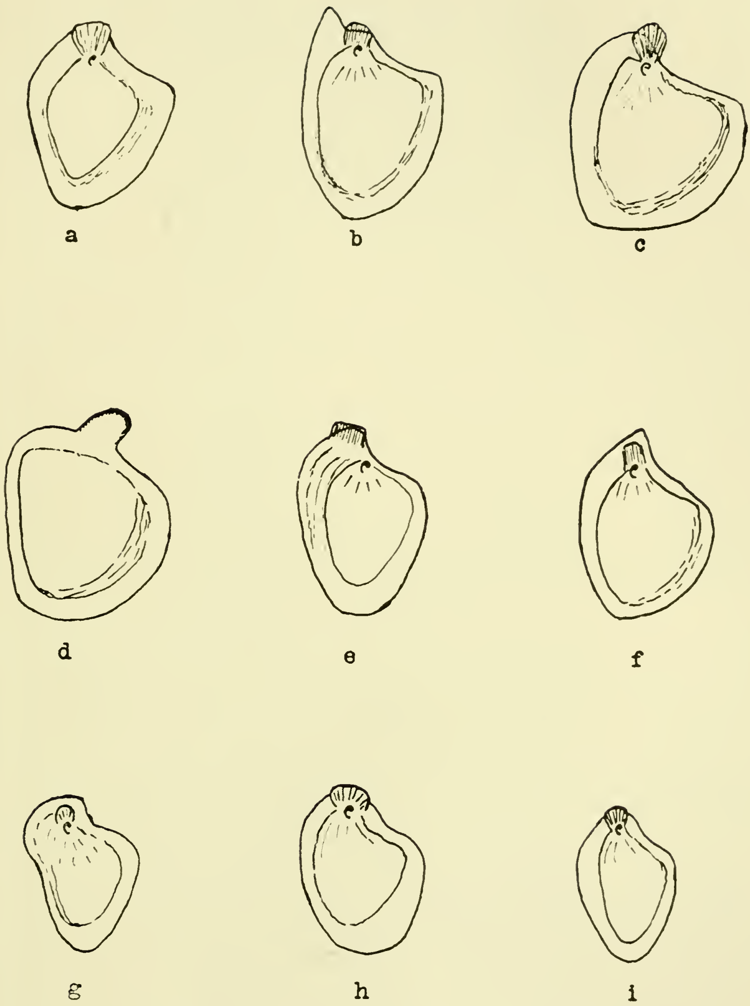
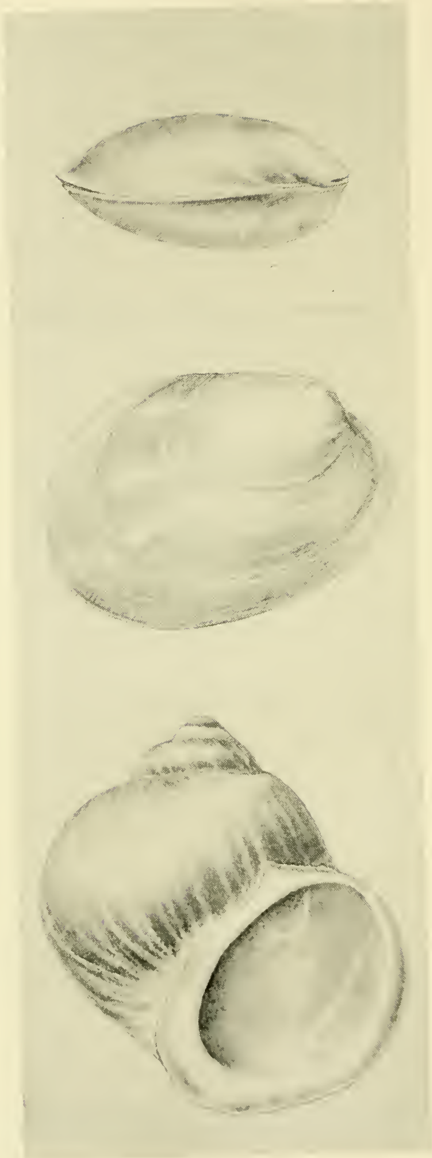


Plate 9. Outlines of shells from various specimens of *Aplysia californica* Cooper. The commas indicate the location of the shell nucleus in each specimen.



Upper 2 figs., *Musculus vernicosus* (Middendorff). Lowest fig., *Littorina arctica* Moeller.

A geological investigation of the islands has been made by Don. J. Miller (1953), of the U. S. Geological Survey. During the course of his work he obtained 20 species of mollusks (identified by F. Stearns MacNeil) from Pleistocene sedimentary beds. Oddly enough, none of these species was found in the collection being considered here. It is practically certain that the lists of both fossil and recent species represent only a small portion of the total molluscan fauna of the island and adjacent waters. No records of land or freshwater forms have been seen.

A report on the vascular flora of Middleton Island was published by Thomas (1957) who listed 116 species and subspecies representing 42 families. He mentioned that the majority of these plants also occur to the north on the mainland of Alaska and on Hinchinbrook Island and Montague Island.

A popular account of this island and its former inhabitants was published by Parker (1923).

We acknowledge with appreciation the assistance of Allyn G. Smith in the identification of some of the species and Margaret M. Hanna for the drawings of the two which are illustrated.

List of species

Pelecypoda: *Cardita prolongata* Carpenter [Dall, 1921, p. 32]. *Musculus vernicosus* (Middendorff). *Mytilus californianus* Conrad. *Mytilus edulis* Linnaeus. *Protothaca staminea ruderata* (Deshayes).

Gastropoda: *Acmaea cribraria* Carpenter. *Acmaea mitra* Eschscholtz. *Acmaea pelta* Eschscholtz. *Acmaea scutum* Eschscholtz. *Buccinum baeri mörchianum* Fischer. *Diodora aspera* (Eschscholtz). *Epitonium (Opalia) chacei* Strong.

Littorina arctica Möller. *Margarites pupilla* (Gould). *Ocenebra lurida* Middendorff. *Ocenebra lurida munda* Carpenter [Dall, 1921, p. 107]. *Searlesia dira* (Reeve). *Thais canaliculata* (Duclos). *Thais lamellosa* (Gmelin).

Amphineura: *Mopalia wosnessenskii* (Middendorff). *Schizoplax brandtii* (Middendorff). *Tonicella lineata* (Wood).

Cephalopoda: *Octopus* sp.

Cirripedia: *Balanus cariosus* Pallas.

Mytilus edulis Linnaeus

Mytilus edulis Linnaeus, 1758, p. 705. "Habitat in O. Europaeo, Indico & M. Balthico."——Dodge, Bull. Amer. Mus. Nat. Hist., Vol. 100, Art. 1, p. 213, 1952.——Soot-Ryen, 1955, p. 19, pl. 1, figs. 1, 2; text figs. 1, 2, 10, 11, 1955.

A few specimens in the present collection are referable to the well-known mussel *Mytilus edulis:* Several names have been proposed for forms of this species occurring in the northeast Pacific. These include *Mytilus trossulus* Gould (1850, p. 344; Schenck, 1945, p. 519, pl. 67, figs. 9-13) described from "Killimook [Tillimook], Puget Sound, Oregon," *Mytilus glomeratus* Gould (1851, p. 92) from "San Francisco," and *Mytilus edulis diegensis* Coe (1945, p. 28; 1946, pls. 1, 2) from the "pier of the Scripps Institution" at La Jolla, California. A monographic study of West American Mytilidae led Soot-Ryen (1952, p. 20) to place these names in the synonymy of *M. edulis* and he stated, "They may be ecological forms or genetically determined, but at present it seems impossible to circumscribe a group of specimens from one locality so well that they can be recognized in a large collection from many localities."

Additional names applied to members of the *Mytilus edulis* clan, rather generally overlooked by west American writers, are those of Nordmann (1862, p. 422, pls. 11, 12) based on forms from "der Insel Edgecombe" near Sitka, Alaska. Nordmann proposed the name *"Mytilus edulis,* forma *gigantea"* (*Mytilus giganteus* Holmberg in litt.) for a giant of *M. edulis* and a further subdivision of this large form into No. 1 *"minor,"* length, 90 mm., No. 2, *"major"* (pl. 11, figs. 1, 2), length, 132 mm., and a huge form, No. 3, *"maximus"* (pl. 12, figs. 1, 2), length, 235 mm. The latter form measured 97 mm. in width, 78 mm. in convexity, and the ligament 135 mm. in length.

The illustrations of the form *maximus* shown by Nordmann on his Plate 12 reveal the presence of very coarse concentric sculpture similar to that on some huge specimens of *Mytilus californianus* Conrad from southeastern Alaska. The latter species is sculptured with radial ribs in addition to the concentric rugae, but sometimes the radial ribs are scarcely visible on shells covered with periostracum. There is therefore an element of doubt as to whether the shell illustrated on Nordmann's Plate 12 might be referable to Conrad's species rather than to *M. edulis.*

The huge form from the Pliocene of northern California illustrated by Manning & Ogle (1950, pl. 8, fig. B) under the name of *"Mytilus edulis* Linnaeus var." with a length of 235 mm. appears to be quite similar to the giant forms of *M. edulis* described

from southeastern Alaska.

According to Taki & Oyama (1954, pl. 12, figs. 20a, b), the species cited by Yokoyama under the name of *Mytilus giganteus* Holmberg from strata of Pliocene age in Japan is referable to *Mytilus crassitesta* Lischke.

MUSCULUS VERNICOSUS (Middendorff) Pl. 10, upper 2 figs.

Mod[iolaria]. vernicosa Middendorff, 1849, part 3, p. 536 (20), pl. 11, figs. 25, 26, 27, 27a. "Das Ochotskische Meer (Midd.); die Inseln Kadjak und Ugak, an der Nordwestküste Amerika's (Wosness.)." Oldroyd, 1924a, p. 78, pl. 28, fig. 11. "Range: Bering Sea to Sitka, Alaska."

Four specimens in the present collection, the largest 10.7 mm. in length, 8 mm. in height, and 4.6 mm. in maximum convexity (both valves together), are here referred to *Musculus vernicosus* (Middendorff). An illustration of Middendorff's species appeared in I. S. Oldroyd's work but the original description was not included in her paper. As an aid to others, it is here cited as follows:

"Testa ovato-oblonga, abbreviata, umbonis a latere antico valde remotis, tumida, tenui, translucente, laevi, area nulla, striarum radialium vestigiis obsoletis solummodo antice detegendis; extus aeque ac rubente-fusca; epidermide adnata vernicosissima; margine tenerrime denticulato." (Middendorff).

The present specimens agree in all particulars with the description given by Middendorff. They also agree with the illustration of *Modiolaria vernicosa* given by I. S. Oldroyd except that the present shells appear to be slightly longer in proportion to the height. The similarity is so great that we are inclined to refer our specimens to the species described by Middendorff.

Judging solely from the original descriptions of *Modiolaria olivacea* Dall (1916, p. 405), which was described from "Off Bering Island, in 10 fathoms," we were at first inclined to refer our specimens to that species. Dall stated that "This differs in sculpture, color, and proportions from the young of *M. laevigatus*."

Modiola laevigata Gray (1824, p. CCXLV. Ref. to Chemnitz, Conch.—Gab., Vol. 8, p. 193, pl. 86, figs. 764a, b; Wood, 1828, p. 8, pl. 2, *Mytilus*, fig. 5) was originally described from Arctic waters. It was cited by Dall (1921) as occurring in west American

waters and was illustrated by I. S. Oldroyd (1924, pl. 3, fig. 5), but in a later publication the same year (1924a, p. 77) this species along with *M. discors* L. was referred to *M. substriata* Gray, 1824, and the range was given as Arctic Ocean to Puget Sound. Jensen (1912) cited both *laevigata* (p. 57, pl. 3, figs. 4a, 4b) and *substriata* (p. 58, pl. 3, figs. 5a, 5b) as varieties of *M. discors* L. The present specimens completely lack the diagonal impression present on shells of the *discors* group.

The illustration of *Musculus olivaceus* (Dall) given by Soot-Ryen (1955, pl. 8, fig. 39) from Oregon, is that of a shell sculptured with well developed radial riblets. If this be typical of Dall's species, it is not at all similar to the present shells from Middleton Island.

LITTORINA ARCTICA Möller. Pl. 10, lowest fig.

L[itorina] arctica Möller, 1842, p. 82 (separate p. 9). Ref. to *"Nerita litoralis* F.G. L. 5, 3."—Philippi, 1848, p. 68 (62), pl. 7, figs. 24, 25, 26. [Ref. to Möller, p. 9, and *Nerita litoralis* O. Fabricius, Fauna Groenlandiae, p. 402 (non Linnaeus)]. "Patria: Mare arcticum Grönlandiam et Novajam Sembljam alluens." *Littorina arctica* (Möller). Kobelt, 1907, p. 63, pl. 111, fig. 6. [Illustration from Philippi]. "Aufenthalt im hohen Nerden, an Grönland und Navaja Semlja."

Littorina grönlandica (Menke). Dall, 1921, p. 153. [Not (of) Menke, Synop. Meth. Moll., p. 45, 1830. Reference to " (Chemn. Conch. Cab. V. fig. 1855, a.b.)," which is a spirally ribbed form].

Several specimens of a low-spired, almost black *Littorina* without sculpture except for growth lines, were among the specimens collected. Some difficulty was experienced in selecting an acceptable name for this form. It is almost certainly the same species to which Dall referred in 1921 as *Littorina grönlandica.* He cited "Tryon, Man., Vol. 9, pl. 41, fig. 7" for an illustration of the species, one which Tryon copied from "Conch. Icon. f. 69," and which he cited as *"Littorina arctica* Moll. (= *littoralis).*" *Littorina littoralis* L. (*Nerita littoralis* L., Syst., Nat., ed. 10, p. 777, 1758; ed. 12, p. 1253, 1767) as generally interpreted is a low-spired very thick shell and would not likely be considered equivalent to the one under consideration. Sars (1878, p. 165, pl. 9, figs. 9, a-b) cited *L. arctica* as a synonym of *Littorina palliata Say (Turbo palliatus* Say, 1822, p. 240. "Inhabits the shores of the New England States"). This later species was considered by

Tryon (1887, p. 303) to be a variety of *L. littoralis* but Kobelt (1907, p. 62, pl. 110, figs. 21, 22; pl. 111, fig. 8; pl. 112, figs. 7-11, 21.) recognized it as a distinct species. It has fine spiral sculpture according to the figures given by him. He also considered *L. arctica* to be a distinct species (1907, p. 63, pl. 111, fig. 6), a decision with which we concur.

Whether this species is as generally distributed as might be inferred from the range given by Dall (1921) for "*L. grönlandica* Menke," namely, "the Okhotsk and Bering seacoasts and eastward to Sitka, Alaska; Puget Sound? Also Greenland," and as might be inferred from his reference to Tryon's figure, is uncertain. We have not found these smooth, clean, unsculptured shells in any other Alaskan collections thus far.

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LAND SNAILS OF E. N. HUYCK PRESERVE, NEW YORK

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Ingram (1941 and 1946) has listed the land mollusks of the Edmund Niles Huyck Preserve,[1] Rensselaerville, Albany County, New York, and has commented upon the utilization of stones for shelter by snails in that area. Seventeen species of snails and three species of slugs were reported from the Preserve. Of about 5000 individual snails observed from June 15 to September 1, 1940, only three specimens (all *Anguispira alternata*) were found beneath stones (a total of 1350 turned over); the other snails occurring under logs, sticks, leaves, humus, etc. From his studies, Ingram concluded that "snails prefer shelter beneath humus and logs (where moist soil exists), to shelter beneath stones where the three are found together on the forest floor" (as at the Huyck Preserve). On the other hand, in a flood plain forest at Ithaca, New York, where logs and debris were absent he found 265 snails beneath stones (956 turned).

During the summer of 1955 the present author turned over many thousands of logs, sticks, rocks, stones, etc., on the Edmund Niles Huyck Preserve in search of salamanders and various arthropods. At first little attention was paid to the molluscan fauna, but a number of snails and slugs were found beneath rocks and stones, contrary to Ingram's contention. Representative individuals were collected in a rather off-hand way, since the author is no expert on these animals, but still the list of species sheltering under stones grew to respectable proportions. In the middle of summer, I decided to make a quantitative estimate of the number of snails which could be collected from under stones. Accordingly, 100 stones (150 on two occasions) were turned over at random in each of a number of different ecological areas. In all, 1400 stones were turned with the following results. (Only living animals were collected. Dead shells which might have been washed under the stones by water or which might have been carried under by shrews, etc., were ignored):

August 11: 150 stones turned in and around crumbling foundations of old felt mill on banks of creek, under young decidu-

[1] For a description of the Preserve, see Odum (1943).

ous trees. Stones were nearly all flat, ranging in size from 3-4 inches to 1-2 feet in diameter; most rested on other stones rather than on soil; dry under most, but some moisture retained in debris under some. Snails found were:

Zonitoides arboreus,[2] 4 examples. *Anguispira alternata,* 5. *Helicodiscus parallelus,* 3. *Punctum minutissimum,* 1. *Gastrocopta contracta,* 1. *Vertigo ventricosa,* 52. *Vertigo gouldi,* 26. Immature (undetermined), 12. Total, 104.

August 11: 100 stones, along path in south side of ravine of Rensselaerville Falls—mostly open, but occasional shrub cover. Stones mostly flat, ranging from 3-4 inches to 1½ feet in diameter, resting on sloping talus; very dry under most.

Stenotrema fraternum, 1. *Euconulus fulvus,* 5. *Zonitoides arboreus,* 5. *Succinea ovalis,* 1. *Vertigo ventricosa,* 2. Total, 14.

August 15: 100 stones in and beside old wall at edge of old apple orchard. Stones mostly flat, 1-2 feet in diameter, and resting on other stones. It was damp under most of the stones at this time but most of the snails found were inactive.

Zonitoides arboreus, 3. *Discus catskillensis,* 2. *Vertigo ventricosa,* 46. *Cionella lubrica,* 35. Immature (undetermined), 3. Total, 89.

August 15: 100 stones, around base of old grist mill near creek, under second-growth deciduous canopy. Stones most flat, from 2-3 inches to 1-2 feet in diameter, and resting on other stones or on debris and trash or firmly embedded in ground; fairly moist under most.

Anguispira alternata, 8. *Zonitoides arboreus,* 1. *Punctum minutissimum,* 3. *Succinea ovalis,* 1. *Gastrocopta pentodon,* 1. *Gastrocopta tappaniana,* 1. Total, 15.

August 15: 100 stones from fallen wall along road, under small deciduous trees and shrubs. Most stones lay on ground but some remained piled on other stones; mostly flat, but some nearly round; 6 inches to 1 foot in diameter.

Stenotrema fraternum, 1. *Triodopsis tridentata,* 2. *Euconulus fulvus,* 2. *Retinella rhoadsi,* 5. *Discus catskillensis,* 2. Immature (undetermined), 13. Total, 25.

August 16: 100 stones in nearly pure, mature hemlock forest at edge of Lincoln Pond. Stones mostly flat; 4-5 inches to 3 feet in diameter; embedded in soil or lying on other stones or debris. Slightly moist under most.

Triodopsis tridentata, 1. *Ventridens intertextus,* 1. *Helicodiscus parallelus,* 1. *Cionella lubrica,* 2. Immature (undetermined), 7. Total, 12.

August 17: 150 stones on steep talus slope on north side of

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[2] I wish to thank Mr. Leslie Hubricht for his aid in identification of the snails mentioned in this paper.

small stream—young sugar maple-hop hornbeam forest. Stones flat; 4-6 inches to 3 feet in diameter; mostly lying on other stones or debris; moist under most. (Since a few snails were lost accidentally from this collection, the numbers reported below are minimal):

Triodopsis tridentata, 1. *Haplotrema concavum*, 1. *Euconulus fulvus*, 1. *Retinella rhoadsi*, 13. *Mesomphix inornatus*, 3. *Mesomphix cupreus*, 6. *Paravitrea multidentata*, 2. *Zonitoides arboreus*, 2. Immature (undetermined), 8. Total, 37.

August 23: 100 stones in flood plain forest at head of Lake Myosotis; ash, elm, maple and basswood predominant. Stones scarce, most embedded in the soil; flat to round, 3 inches to 1½ feet in diameter. Soil moist, and worms present under many stones.

Euconulus fulvus, 1. *Helicodiscus parallelus*, 2. Total, 3.

August 24: 100 stones in mature beech-hemlock forest N. E. of Lincoln Pond. Most stones flat, 3 inches to 1½ feet in diameter; most embedded in soil but some lying on other stones. Only two snails found, both under the same large rock near a brook. Immature (undetermined), 2.

August 26: 100 stones in fallow field on south side of hill. Stones 6 inches to 2 feet in diameter. Sun had warmed stones so that most were dry beneath, but the larger and thicker ones were moist on the undersides. *Vertigo ventricosa*, 3.

August 26: 100 stones in young maple-hop hornbeam forest on north slope of hill (same as above). Most stones flat—4 inches to 2 feet in diameter, dry beneath, though soil was moist under them.

Mesomphix cupreus, 3. *Ventridens intertextus*, 1. *Helicodiscus parallelus*, 3. *Vertigo ventricosa*, 2. Total, 9.

September 2: 100 stones under large, mature sugar maples along stream. Stones 3 inches to 1 foot in diameter, some on soil, some on other stones. Soil quite damp and undersides of most stones also moist.

Retinella rhoadsi, 4. *Paravitrea multidentata*, 1. *Ventridens intertextus*, 1. *Zonitoides arboreus*, 1. Immature (undetermined), 5. Total, 12.

September 2: 100 stones in old wall paralleling stream (same as above) under young sugar maples. Stones from 6 inches to 3 feet in diameter; most lying on other stones; many with accumulation of organic debris beneath.

Euconulus fulvus, 11. *Zonitoides arboreus*, 7. *Striatura exigua*, 1. *Gastrocopta pentodon*, 1. *Vertigo ventricosa*, 2. Immature (undetermined), 4. Total, 26.

Thus, a total of 351 living specimens of shell-bearing snails were taken from under 1400 stones or rocks. Of these, 297 were

identifiable and proved to represent no less than 22 species!

Other species, specimens of which were found beneath rocks on the Huyck Preserve, incidental to the collection of other animals, are the following:

Triodopsis albolabris, 1 specimen. *Hawaiia minuscula,* 1 specimen. *Vertigo milium,* 2 specimens. *Carychium exiguum,* 1 specimen.

Furthermore, a number of small slugs were observed beneath stones. A few of these were collected, but were immature and remain unidentified. It is, therefore, not certain which of the four slugs known to occur on the Preserve may seek shelter under rocks.

The following five species have also been found on the Huyck Preserve but have not yet been observed to occur beneath stones in that area: *Mesodon sayanus, Triodopsis dentifera, Triodopsis notata, Ventridens ligerus,* and *Oxyloma retusa.*

The above evidence clearly indicates that the great majority (at least 27 out of 35) of the terrestrial snails found on the Huyck Preserve may at one time or another crawl beneath rocks and stones. Some, such as *Triodopsis albolabris, Haplotrema concavum* and *Succinea ovalis,* may seek such shelter only rarely, while others, such as *Euconulus fulvus, Helicodiscus parallelus, Vertigo ventricosa* and *Cionella lubrica* may very commonly occupy this habitat. Since no count or collections were made of specimens under logs, bark, leaves, etc., no accurate comparison can be made of the relative desirabilities of these various habitats. Seemingly, however, snails utilize the most convenient suitable shelter when conditions in the open send them into hiding. Where only stones or only logs are available, then these objects must be used exclusively. But where rocks and logs are present together, then both may be utilized more or less equally, depending on the conditions of space and moisture (and food?) beneath each.

A further result of this study is the addition of a number of species to the list of terrestrial gastropods found on the E. N. Huyck Preserve. Ingram (1946) has listed 20 species, including 3 slugs. To this we can now add 15 species, including the slug *Limax maximus.* The list below now includes the following species (* indicates species added by this study):

Stenotrema fraternum (Say)
**Mesodon sayanus* (Pilsbry)
Triodopsis tridentata (Say)
T. albolabris (Say)
T. dentifera (Binney)
T. notata (Deshayes)
Haplotrema concavum (Say)
Euconulus fulvus (Müller)
**Retinella rhoadsi* (Pils.)
Mesomphix inornatus (Say)
M. cupreus (Rafinesque)
**Paravitrea multidentata* (Binney)
**Hawaiia minuscula* (Binney)
**Ventridens ligerus* (Say)
V. intertextus (Binney)
Zonitoides arboreus (Say)
**Striatura exigua* (Stimpson)
**Limax maximus* Linnaeus
Deroceras laeve (Müller)
Anguispira alternata (Say)
Discus catskillensis (Pils.)
Helicodiscus parallelus (Say)
**Punctum minutissimum* (Lea)
Arion circumscriptus Johnston
Philomycus flexuolaris (Raf.)
Oxyloma retusa (Lea)
Succinea ovalis (Say)
**Gastrocopta contracta* (Say)
**G. pentodon* (Say)
**G. tappaniana* (C. B. Adams)
**Vertigo milium* (Gould)
**V. ventricosa* (Morse)
**V. gouldi* (Binney)
Cionella lubrica (Müller)
**Carychium exiguum* (Say)

This list is probably fairly representative of the snail fauna of the Helderberg Plateau in the southern and western part of Albany County, New York. It is, however, not at all complete. This contention is strongly indicated by the ease with which the present writer, no expert in the field, has nearly doubled the number of reported species. The small forms such as *Retinella, Paravitrea, Hawaiia, Striatura, Punctum, Gastrocopta, Vertigo,* and *Carychium* were missed entirely by Ingram, and others most probably have been overlooked by me. Further, assiduous collecting in the area undoubtedly will add other species to the list. In particular, three snails, found at other places on the Helderberg Plateau, might be expected at the Preserve. These are:

Strobilops sp., Bear Swamp, Westerlo.
Gastrocopta armifera (Say), J. B. Thacher State Park.
Carychium exile H. C. Lea, J. B. Thacher State Park.

In summary: the land snail fauna of the Edmund Niles Huyck Preserve is considerably richer than was formerly believed, and a large number of these snails do at one time or another seek shelter beneath rocks and stones.

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INLAND MOLLUSKS FROM HUDSON BAY, MANITOBA*

By WILLIAM J. WAYNE
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Little has been published on the distribution of land mollusks in the eastern part of the Canadian Arctic and Subarctic. Because of this geographical and ecological data are less well known than might be desired. Ecological notes are of particular value to students of the environmental conditions that surrounded the Pleistocene ice sheets. Arctic and subarctic molluscan assemblages are frequently recovered as fossils from silt beds between till sheets and from the loess deposits southward from the glacial boundary (Leonard, 1952, 1953; LaRocque and Forsyth, 1957; Wayne, 1958).

Dall (1905) summarized the published information that was available to that date. Oughton (1940; 1948) and Brooks and Brooks (1940) added records for Baffin Island, Labrador, northern Ontario, and Newfoundland. No records of nonmarine mollusks from either Churchill, Manitoba, or Southampton Island, N. W. T., seem to have been published, although Mozley (1937) noted the presence of *Vertigo* sp. near Fort Churchill.

On August 9, 1957, I was able to collect mollusks in the vicinity of the airstrip near Churchill. During the following sixteen days, I examined five areas in the south and west parts of Southampton Island, where I made geological observations, for the presence of land mollusks. Both the positive and negative results of this collecting are presented here in order to place the additional distributional and ecological data on record.

Churchill is on the southwest coast of Hudson Bay, at the mouth of the Churchill River. The airfield, where these mollusks were collected, is about five miles east of the town, approximately at latitude 58°45′ north and longitude 94°05′ west. The northern limit of coniferous forests is a few miles south of Churchill (Ritchie, 1956; 1957). Stunted spruce trees, along with larch, dwarf birch, and willow, grow on drier ground all

* Dr. D. G. Frey and John Stahl, Zoology Department, and Dr. George Neumann, Holm Neumann, and W. R. Adams, Anthropology Department, all of Indiana University, assisted in the collecting at Churchill. Mr. John Buehler, president of Indiana Gear Works, Indianapolis, Indiana, made the trip possible. Dr. Aurele LaRocque, Ohio State University, has reviewed the manuscript.

the way to the coast, but the low ground is almost entirely muskeg covered with scattered tundra ponds. The mean annual temperature at Churchill is about —8°C (19°F) and mean annual total precipitation is about 13 inches, of which 10 inches falls as rain. Mean July temperature is 13°C (55°F), mean summer (June through September) temperature is 9.3°C (49°F), and mean January temperature is —28°C (—19°F).

Permanently frozen ground is reported to be continuous and is found to a depth of about 140 feet (Jenness, 1949, p. 19-20). Features of the topography, vegetation, climate, and geoglogy at Churchill are summarized in a recent report on temperature gradient in the active layer of the soil by Beckel (1957, p. 152-154).

Land mollusks were moderately abundant on sedges in the muskeg and around the edges of tundra ponds, and on the drier slopes as high as 3.0 meters above the muskeg, where they were found beneath rotting spruce logs, flat rocks, and cardboard and crating lumber debris. During several hours of collecting along the west edge of the airstrip, 106 individuals representing 8 species of land mollusks and one species of aquatic snail were found.

Coral Harbour, the only permanent settlement on Southampton Island, N. W. T., is located approximately 64°08′ north, longitude 83°10′ west. Mean annual temperature is —12°C (10°F) and mean annual total precipitation is about 10 inches, of which five inches falls as rain. Mean July temperature is 7.5°C (45°F) and mean summer temperature is 4°C (39°F). The Points is a high ridge in the interior of the southwestern part of Southampton Island, and the locality examined is latitude 63°36′ north, longitude 85°03′ west. Low areas everywhere on the island are tundra ponds and muskeg; slopes and higher ground at Coral Harbour are bare exposures of gneiss. At all other localities I visited, they are limestone and glacial drift rubble.

Land and fresh-water mollusks seem to be rare on Southampton Islands. Likely habitats were examined at five places in the southern part of the island. Two of these, Coral Harbour and The Points, yielded a few specimens of the slug, *Deroceras laeve* (Müller), but no mollusks were found at any of the other

three localities examined: Manico Point, a small point along the coast about eight miles north of Ruin Point, and an area about 3 miles west of the mouth of Kirchoffer River.

Columella alticola (Ingersoll).

An arctic-alpine species, this cylindrical pupillid has been recorded in eastern North America from Baffin Island (Oughton, 1940) and from the northern coast of Ontario (Oughton, 1948, p. 48-9). In the Rocky Mountains it is usually collected from high altitude stations (Ingersoll, 1876). Only one specimen was collected at Churchill.

Deroceras laeve (Müller).

Beside the airstrip at Churchill 10 specimens were collected from the underside of rocks, pieces of wood, and cardboard, from water level at the edge of a tundra pond to about three meters above pond level on a slope. Most of the individuals were found near water level.

Five specimens of this small, dark-colored slug were the only land mollusks found on Southampton Island. Mucous trails were abundant on the lower side of flat rocks along tundra brooks at the Points, but only one specimen was located. Four specimens were observed beneath pieces of crating lumber and cardboard just above water level in muskeg within about 300 meters of the settlement at Coral Harbour. Inasmuch as most of the specimens of *Deroceras* came from the vicinity of the only permanent settlement in the island, one might speculate that the slug could have been introduced in the island by man.

Euconulus fulvus (Müller).

Like the slug, *Deroceras,* this species was found beneath trunks of fallen spruce trees, pieces of paper, and cardboard from water level at the margins of tundra ponds to about three meters above the water on a dry slope. Twelve specimens were collected.

Lymnaea cf. *L. arctica* Lea.

One fresh-water mollusk was so abundant along the edge of open pools of water in the muskeg at Churchill that it could not be overlooked, even though no systematic search was made for aquatic species. This species was in nearly all ponds and pools of fresh water examined, and was collected in three places: from a small pool on the beach at the base of the rocky bluffs at Fort Churchill, in some of the small rock basins in the quartz-

ite bluffs, and beside the airstrip in the muskeg. The 35 specimens collected were referred to *Lymnaea arctica* according to the classification of Huebendinck (1951). Dall (1905, p. 75) listed *L. arctica* as a synonym of *L. vahlii* Müller.

Pupilla muscorum (Linné).

Three specimens of *P. muscorum* were found beneath cardboard debris or fallen spruce wood between one and three meters above the muskeg. A circumboreal species, it is widely distributed in northern United States and Canada. Oughton (1940, p. 54) collected it in Ontario from localities along the southwest coast of Hudson Bay, so its presence at Churchill was expected.

Succinea avara Say.

Species of *Succinea* are difficult to identify positively from shell characteristics alone, and no anatomical studies have been made on this material. The fifteen specimens collected from the sedges and mud at the margins of ponds in the muskeg at Churchill that I have referred to *S. avara* differ somewhat from living Indiana specimens identified as *S. avara*, but the shells of the Churchill specimens are identical in all characteristics to specimens recovered from Pleistocene Wisconsin Stage sediments in Indiana. It also fits closely the descriptions of *S. grosvenovii gelida* F. C. Baker and *S. oblonga* Draparnaud.

The most noticeable differences between the group collected at Churchill and the species now living in Indiana are those of size of shell and size and shape of aperture. Measurements of 5 mature specimens of the Churchill lot are given in table 1.

TABLE 1. *Succinea avara* and *S. verrilli*

	Succinea avara					*S. verrilli*		
No. of Whorls	3¼	3¼	3¼	3¼	3¼	3	3	3
Length (mm)	6.0	6.5	6.1	5.6	6.5	8.5	8.5	7.0
Width (mm)	3.5	3.6	3.5	2.9	3.7	4.8	4.9	3.8
Aperture Length	3.1	3.3	2.8	3.2	3.3	5.3	5.1	4.6
Aperture Width	2.0	2.3	2.0	2.0	2.3	3.5	3.0	2.9
Ratio W/L	0.58	0.56	0.57	0.52	0.57	0.57	0.58	0.54
Ratio Aper. L/L	0.52	0.51	0.46	0.57	0.51	0.63	0.60	0.66

Succinea (*Oxyloma*) *verrilli* (Bland)

Nineteen specimens of *Succinea verrilli* were collected from the same environment as *S. avara* at Churchill. About half were alive when taken; the rest were empty shells in good condition.

Dall (1905, p. 57) regarded *S. verrilli* to be a synonym of *S. avara*. However, the specimens collected at Churchill fall easily into two distinct species, one of which has been discussed under *S. avara,* the other of which fits the description and measurements of *S. verrilli* as presented in Pilsbry (1948, p. 777). Brooks and Brooks (1940, p. 72) reported the species from northwestern Newfoundland. Oughton (1940, p. 77) gave measurements for two "*S. retusa*-like shells" from Fort Severn, Ontario, that may be *S. verrilli.*

For comparative purposes, the measurements of 3 of the mature specimens in the Churchill lot are in table 1.

Vertigo alpestris Alder var. *oughtoni* Pilsbry.

Ten specimens of *V. alpestris oughtoni* were collected from the boggy flat and the adjacent slope up to about two meters above the muskeg water level at the Churchill airstrip. Most of the specimens were found beneath pieces of fallen spruce wood and crating lumber. This seems to be the first record of a living colony of this species from the North American mainland, although Oughton (1948, p. 55) collected shells in river drift at Fort Severn, Ontario, and it is well known as a fossil in Pleistocene sediments south of the Great Lakes (Leonard, 1953; LaRocque and Forsyth, 1957; Wayne, 1958). The only living colonies previously reported are from Newfoundland (Brooks and Brooks, 1940, p. 61) and Frobisher Bay, Baffin Island (Oughton, 1940, p. 128).

Because so few records of living colonies of this snail have been published, measurements of 9 of the 10 specimens collected at Churchill are listed for reference. Slight differences from those collected by Oughton probably result from minor variations in environmental conditions. Two of the specimens have a very small angular lamella; sculpture on all specimens consists of very fine striae.

Table 2. *Vertigo alpestris oughtoni*

No. of Whorls		4	4½	4	4½	4	4	4½	4	4
Length (mm)		2.2	2.1	2.3	2.0	2.3	2.3	2.2	2.3	2.2
Width (mm)		1.3	1.2	1.4	1.3	1.3	1.3	1.2	1.3	1.3
Teeth	parietal	1	1	1	1	1	1	1	1	1
	angular	0	1	0	0	0	0	0	0	1
	columellar	1	1	1	1	1	1	1	1	1
	palatal	2	2	1	2	1	2	2	2	2

Vertigo binneyana Sterki.

The single specimen of this species collected was found beneath a flat rock embedded in wet peaty soil among quartzite outcrops above Hudson Bay at Fort Churchill. The only other species collected near it was *D. laeve*.

Oughton (1948, p. 56) reported one lot from Fort Severn in Ontario and stated the species might not extend farther east. It is also recorded from Montana, British Columbia, and Winnipeg, Manitoba (Dall, 1905, p. 31).

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JOHN T. GULICK'S HAWAIIAN LAND SHELLS

By WILLIAM J. CLENCH

During the middle 1800's the Reverend John T. Gulick amassed a very large collection of Hawaiian land shells, which had been collected mainly on the island of Oahu. When Mr.

Gulick had finished his studies and observations on this material, he divided it up into 20 sets or "collections." The #1 collection contained all his holotypes and a series of specimens from each locality where material had been collected. Each succeeding collection contained fewer named forms and fewer specimens.

These collections (1-20) were sold or donated to several institutions as indicated in the following table.

The author is greatly indebted to Dr. Addison Gulick, the son of Reverend John T. Gulick, for these data.

No.	Named forms	No. of Shells	Present location
1	273*	9,000[1]	BSNH 1897—MCZ 1914
2	230	4,510	Hawaiian Museum, C. 1873
3	227	3,614	BSNH 1889—MCZ 1914
4	219	2,990	ANSP and BPB—1906
5	212	2,781	MCZ 1957, AM 1958
6	202	2,148	MCZ 1957, AM 1958
7	194	2,036	ANSP and BPB 1906
8	192	1,935	ANSP and BPB 1906
9	187	1,686	ANSP and BPB 1906
10	183	1,559	MCZ 1914
11	179	1,552	ANSP and BPB 1906
12	176	1,442	ANSP and BPB 1906
13	175	1,384	ANSP and BPB 1906
14	173	1,224	BPB 1923
15	171	1,189	BPB 1923
16	167	1,154	ANSP and BPB 1906
17	166	1,143	ANSP and BPB 1906
18	166	1,110	Wellesley Coll. C. 1872
19	164	1,075[2]	Oahu Coll. C. 1872
20	163	1,041[3]	Univ. of Mo. 1914

BSNH — Boston Society of Natural History
MCZ — Museum of Comparative Zoology, Harvard University
ANSP — Academy of Natural Sciences, Philadelphia, Penna.
BPB — B. P. Bishop Museum, Honolulu, Hawaii
AM — Australian Museum, Sydney, Australia
UM — University of Missouri

Collections #1 and #3. These two collections were obtained by Alpheus Hyatt for the Boston Society of Natural History. They

[1] Estimated indirectly from the size of this collection when sold.
[2] Estimated by averaging figures from Numbers 18 and 20.
[3] A figure in lead pencil, not perfectly legible.

were turned over to the Museum of Comparative Zoology in 1914 when the Boston Society of Natural History restricted its interests to the New England area.

Collection #2. This collection was given to the Hawaiian Museum about 1873. This was a private museum of the Hawaiian royalty. The shell collection has disappeared or was destroyed; at any rate there is no evidence of its existence today. Certain of the ethnological material was given to the B. P. Bishop Museum.

Collections #5 and #6. These two collections remained in the Gulick family until this year (1957), when both were donated to the Museum of Comparative Zoology. Since these collections would add but little value to the Gulick material now in our possession, we decided, with Dr. Addison Gulick's consent, that they should be located elsewhere. They have, accordingly, been sent to the Australian Museum in Sydney.

Collection #18. This collection was obtained by Wellesley College about 1872. It was stored in College Hall which was completely destroyed by fire in 1914.

Collection #19. This collection was obtained about 1872 by Oahu College (now Punahoa School) and is now believed lost.

All the remaining collections are in the collections of the institutions named above in the table.

Excess specimens beyond collection #20 were used by Gulick for exchange with C. B. Adams, T. Bland, W. G. Binney, Y. Hirase, and many others.

In summation, 17 of the collections which are still in existence are now a part of the collections of 5 institutions—the Museum of Comparative Zoology, Academy of Natural Sciences of Philadelphia, The B. P. Bishop Museum, Honolulu, The Australian Museum, Sydney, Australia and the University of Missouri.

Most of the Gulick material was "low land" in locality. Much of it was collected at altitudes under 1500 feet. The Reverend John Gulick once told Dr. C. M. Cooke that he had seldom collected any shells above 1500 feet, while Dr. Cooke told me that he (Dr. Cooke) had rarely collected below this altitude.

At the time of my stay in the Island, in 1941-1942, we had to climb up to 2200 feet in the Waianae Mountains to be able to collect any *Achatinella*. Thus, a once remarkable endemic fauna

has almost completely disappeared. This holds not only for Oahu but for all the other islands. Cutting down the original forest to make way for the cattle industry, and then such highly profitable crops as sugar cane and pineapple, left but little of the lowland forests. Introduced important forage grasses soon began to push up the mountain sides, forming dense mats of grass under the trees which prevented the natural seeding of the local flora. Thus the destruction continues, arrested only in areas providing watersheds and in forest reserves where reforestation has been instituted. In addition, introduced rats and ants have doubtless been important factors in exterminating many of these as well as other species in the Hawaiian land snail fauna.

We owe much to many early collectors like Newcomb, Pease and Gulick, as well as to many later collectors such as Thwing, Meinecke, Cooke, Meadows and Thaanum, who by their interest and industry have left behind a heritage of priceless material for generations of future students.

UNIONIDAE FROM UPPER ST. LAWRENCE RIVER

By ARTHUR H. CLARKE, JR.

During construction of the St. Lawrence Seaway and consequent temporary drainage of portions of the St. Lawrence River north and west of Massena, New York, a unique opportunity was presented to make thorough collections of unionids from an area in which extensive collecting is ordinarily very difficult. The region is now inundated by a large, newly created lake held in place by Long Sault Dam located just west of Cornwall, Ontario. Such alteration from large river to lake conditions can be expected to have a marked effect on the species composition. The following lists are given to establish distributional records for the species concerned and to facilitate recognition of the faunal changes which will probably occur. No previous report on the unionids of the St. Lawrence River has been published.

The most productive locality within the accessible portions of the drained areas was at the southwest extremity of Sheek Island at Long Sault Rapids, about eight miles west of Corn-

wall, Ontario, on and slightly north of the International Boundary. A very extensive mud and gravel area was exposed and dead mussels *in situ* were exceedingly abundant. The locality was visited by the writer on June 16 and July 10, 1957, and by Mr. H. D. Athearn of Cleveland, Tennessee, on July 6, 1957. The species which were found are listed below in the order of their abundance.

Elliptio complanatus (Sol.), very abundant.
Lampsilis radiatus (Gmelin), abundant.
Lampsilis ovata ventricosa (Barnes), common.
Ligumia recta (Lamarck), uncommon.
Alasmidonta marginata (Say), rather rare.
Elliptio dilatatus (Raf.), rather rare.
Strophitus rugosus (Swain.), rather rare.
Alasmidonta undulata (Say), rare.
Anodonta cataracta (Say), rare.
Lasmigona costata (Raf.), rare.
Anodontoides ferussacianus (Lea), rare.*
Obovaria olivaria (Raf.), one specimen.*

On July 10, 1957, the author also collected at Waddington, New York, in a drained portion of Little River, an arm of the St. Lawrence River now also inundated by the lake formed above Long Sault Dam. A careful search was made of the very large area of exposed dry mud, and although unionids were everywhere, in three hours only three species were found. They are:

Elliptio complanatus (Sol.), abundant.
Lampsilis radiatus (Gmelin), abundant.
Anodonta grandis (Say), rather common.

RADULA OF LIOMESUS STIMPSONI DALL

By JAY A. WEBER

In describing *Liomesus stimpsoni,* Dall expressed doubt as to its generic position, because the soft parts of his specimen were lacking. Recently I received the soft parts from a specimen taken in 75 fathoms off St. Augustine, Fla. On removing the radula, I found it to be quite different from the radula described by Thiele and Fischer. Thiele shows the radula of *Liomesus dalei* and Fischer that of *Liomesus eburneus.* Both illustrations

* Collected and identified by Mr. H. D. Athearn.

show the central tooth as a rounded rectangular plate and the laterals as single tusks. The radula of *stimpsoni* differs radically from that of *Liomesus,* confirming Dall's doubt as to its generic position.

The radula of *Liomesus stimpsoni* has an arrow-shaped central tooth and the laterals are bi-cusped as shown by the illustration.

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PAUL RANDOLPH BURCH
1898 - 1958

The death of Paul Randolph Burch on January 9, 1958, brought to a conclusion the activities of a teacher, scientist, and malacologist who had devoted his life to biology and who had exerted a great deal of influence on those who knew him. Born in Martinsville, Henry Co., Va., on April 27, 1898, he attended public schools and in 1915 entered Randolph Macon College from which he received a B. S. degree in chemistry in 1920. His studies were interrupted during his employment: as a chemist, by the U. S. Government in explosive plants 1918-19 and by the Domestic Coke Corp., Fairmont, W. Va., 1920-21: and as a teacher, at the Mineral, Virginia, High School, 1921-22; Ferrum Training School, 1922-24; Morris Harvey College, 1924-26; and Radford College, 1928. The M. S. and Ph. D. degrees in biology were conferred by the University of Virginia in 1927 and 1930, respectively. His research at that time resulted in the demonstration of basal granules of the endodermal flagella of hydra; and the effect of injury caused by excision of cytoplasm, loss and gain of cytoplasm on the division rates of *Arcella vul-*

garis and *A. rotundata.*

Dr. Burch continued to serve Radford College as Professor of Biology and Head of the Department until ill health compelled his retirement in 1954. The summers of 1936-45 were spent at the Mountain Lake Biological Station, four of them as an instructor. He was a man of boundless energy, sincerity, and intellectual integrity.

His keen interest in the Mollusca resulted in his being commissioned in 1935 by the Virginia Academy of Science to study particularly the mollusks of Virginia. He spent as much time on the assignment as his teaching duties would allow. During the years which followed, he acquired an excellent collection, approximating 300 species of land and freshwater mollusks from all over the state. He contributed to the collections of the U. S. National Museum and the University of Michigan Museum. Among his more notable publications in malacology is the study of the chromosomes of polygyrid snails (with Ladley Husted), which is considered to be the most comprehensive study of chromosomes of any group of mollusks. His discovery of a new species of snail which he designated as *Polygyra virginiana* reflects his affection for his native state. An avid systematist, his ultimate goal was a monograph of the mollusks of Virginia, and at the time of his demise, several manuscripts were well underway.

Dr. Burch seemed to be driven by a consuming desire and great urgency to promote respect and concern for biology with particular emphasis on and recognition of Virginia's needs.

He was a member of: American Association for the Advancement of Science (Fellow, 1933), American Malacological Union, American Genetics Association, Society of the Sigma Xi, Chi Beta Phi (Life Member), Shenandoah Natural History Association, Society of Systematic Zoology, and the Virginia Academy of Science.

He is survived by his widow, Doris Katherine (Fisher) Burch, and by four sons: David, John B., Richard T., Donald C.; and a daughter, Mary Sharon Burch.

The name of Paul Burch will bring varied recollections to those who knew him—the boy scout who captured hellbenders, the player who shared his tennis court, the biology teacher who

respected his opinion, the student in whom he had faith, the colleague who admired him, the family of which he was so proud, and the malacologists whose friendship he valued so highly. Once when referring to the teaching of our "American Tradition" and the freedom we enjoy, he wrote, "With it (American Tradition) we should be proud of what we have accomplished and at the same time humble that we have accomplished so little . . ."—J. Frances Allen, National Science Foundation.

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PAUL RANDOLPH BURCH

NOTES AND NEWS

George D. Beatty, who died August 30, 1958, was born at Bloomingville, Ohio (Sandusky, R.R. #2) in 1881. He was a member of Spanish-American War Veterans, Perseverance Lodge F. & A.M., Oxford and Pomona Granges, Sandusky Kiwanis Club and Sand Hill Methodist Church. He also had been a member of the American Malacological Union and a subscriber to the NAUTILUS for several years. He was instrumental in establishing the Erie Co. 4-H Club at Kelleys Island and this spring a Natural History Museum was opened at the camp named in his honor. Mr. Beatty was a fine man and will be missed greatly not only in Ohio, but also in Bradenton Beach, Florida, where he and Mrs. Beatty spent their winters. According to his wishes, Mrs. Beatty is giving his entire shell collection and mounted sea animals to the museum.—Mrs. Harry M. Smith.

Netherlands Malacological Society.—On July 1, 1959, it will be 25 years since the Netherlands Malacological Society was founded. In commemoration of that event, the Society intends to organize a meeting on June 27 and 28, 1959, in Amsterdam, and on June 29, 1959, in Leiden. The following is the provisional program:

Saturday, June 27: Opening of an exposition illustrating various aspects of malacology in the Zoölogical Museum of the Municipal University at Amsterdam.—Banquet.—Lecture about some malacological subject.

Sunday, June 28: Excursion to some locality rich in Mollusca in a characteristic Dutch landscape.

Monday, June 29: In the morning, short papers to be published afterwards in Basteria can be read. The afternoon will be devoted to a discussion of the problems with which the curators of public collections of Mollusca are faced, and of the possibilities of a closer cooperation of these keepers.

Foreign malacologists who want to attend this meeting are welcome, and are requested to give provisional notice of their intention to the secretary of the Society, Mr. J. J. Bernard, Nieuwersluisstraat 67, 's-Gravenhage, Netherlands, before January 1, 1959. They will receive the definite program with a re-

quest for a definite promise of attendance before March 1, 1959.—C. O. van Regteren Altena, Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.

South American Trip.—In April, I returned from southern Chile, where I alone comprised the University of California 6th Botanical Expedition to the Andes. I explored the tops and ridges of 5 of the coastal cordilleras in Malleco, Valdivia, Osorno and Llanquihue provinces. The principal quest was for subantarctic plants, including all the visible cryptogams. Although I diligently searched for terrestrial mollusks, I found none in the south except 2 species of *Bulimulus* in the Nauelbuta Mts. of Malleco, and of course *Chilina* from every stream which had them.

On the way home, I visited Prof. Wolfgang Weyrauch, chief zoölogist of Peru, and he took me on an excursion into the highlands, where he also took Dr. Pilsbry. Weyrauch is a very competent naturalist and a delightful companion. He has been 12 times down into the stifling heat of the Maranyon Valley, the very deep and difficult gorge of the true headwater stream of the Amazon. He believes it is the richest of the little known areas of the world for undiscovered biota of all kinds. From every excursion he makes to that area, he brings back hundreds of new species of zoölogical material.—Walter J. Eyerdam (from letter).

North Dakota Record for Arion ater.—In August of 1952 I was called by a neighbor, Ray Nystrom, who had a "peculiar looking creature" on his porch. It was a large slug which I put in a jar of alcohol and placed on a storeroom shelf for several years. This specimen was included in a shipment of slugs sent to Dr. H. A. Pilsbry of the Philadelphia Academy of Natural Sciences. Dr. Pilsbry identified the slug as *Arion ater* (L.) with the comments, "It is an introduced species known only from a few widely scattered localities in Newfoundland, Michigan and Oregon, so there have evidently been several introductions but little spreading. It is common and occasionally destructive in all northern Europe." In response to my inquiry as to whether this was the large slug encountered in the Douglas

Fir forests of the Pacific Northwest, he replied, "Although *A. ater* has been found in a garden in Oregon, the common large slug of those parts is a native species of *Ariolimax*."—Richard L. Post, Asso. Prof. of Entomology, N. D. Agricultural College.

Americana and Indica Clessin 1879. These two names for clams of the family Corbiculidae have escaped notice by all subsequent molluscan students, as well as by the compilers of indices of generic names:

Americana Clessin [Conch. Cab., *9* (3) : 228: 1879] was briefly differentiated and stated to include the American species of *Cyrena*. Originally included (in the same part #283 of this monograph) were 21 specific names, with others in synonymy. Since members of the groups currently known as *Polymesoda* Rafinesque 1820, *Pseudocyrena* Bourguignat, 1854, and *Neocyrena* Crosse and Fischer, 1894 were included, three choices have been open for the selection of a genotype. I wish hereby to designate one of the originally included specific names, *Cyrena sordida* Hanley 1844, as the genotype. Since *sordida* is a synonym of *P. caroliniana* (Bosc), *Americana* in this way is fixed as a junior synonym of *Polymesoda* Rafinesque, 1820, and so cannot displace the subsequent name, *Neocyrena* Crosse and Fischer, 1894.

Indica Clessin [Conch. Cab. *9* (3) : 229: 1879] was more restricted in its original concept. Since Clessin gave this name to "the group of *Cyrena ceylanica*," I wish hereby to designate *Cyrena ceylanica* Clessin 1879 as the genotype. This designation of *Cyrena ceylanica* Clessin (= *C. ceylonica* Mousson = *C. zeylanica* Lamarck = *Venus coaxans* Gmelin) fixes *Indica* Clessin as a junior synonym of *Geloina* Gray 1842, with both in possession of the same genotype.

Selection of type species for the unused names, *Americana* and *Indica* Clessin, as above, will keep both under cover of synonymy, and so avoid unnecessary disturbance of nomenclature of the family Corbiculidae.—J. P. E. Morrison, U. S. Nat. Museum.

Method used by C. B. Adams in describing and measuring shells.—Each shell description by C. B. Adams was a composite of all the specimens he had of the species. This, of course, is a

valid procedure as a "species" is made up of individuals, and such a description should at least embrace the descriptive characters of a unit population. This procedure fails when two or more species are described as a single species, which happened several times in Adams' descriptions. So far as we can determine, Adams used composite measurements. This was not detected until R. D. Turner[1] republished his Western Panama marine species. In this report, Adams gave the number of specimens collected. In checking such type series where all specimens remained, no one specimen had the measurements given by Adams. He simply measured each specimen, totalled these measurements and then divided by the number of specimens in his series. His measurements held only when he based a species upon a single specimen.—W. J. CLENCH.

MEASUREMENTS BY C. B. ADAMS.—Adams, like most of his contemporaries, had no concept of a type specimen. Dr. Pilsbry often told me that he felt that, in many cases, the shell from which the species was described was distributed later, especially if Adams got a better (or bigger) example. For this reason, unless Adams mentioned definitely more than one specimen in his original description, I still would consider his dimensions as part of the description of the only type shell. Also, one should remember that, although undoubtedly the Adams collection is now getting the very best of care, the Museum of Comparative Zoölogy received it almost a century after 1851.—H. B. B.

PUBLICATIONS RECEIVED

ANOTHER BRAZILIAN SPECIES OF "TAPHIUS." By W. Lobato Paraense & Newton Deslandes. Rev. Brazil. Biol. 18 (2):209-217, 5 figs. 1958. The shell and animal of *T. phillippianus* are described and figured excellently. But, according to the "rules," is not *Planorbina* Haldeman (1843), which was proposed very briefly without species, the correct name of the combined genus *"Taphius"* H. & A. Adams (1855)? I never could comprehend why Dall's (1905) addition of *Planorbis olivaceus* "Spix," which

[1]Turner, R. D., 1956: The Eastern Pacific Marine Mollusks Described by C. B. Adams. Occ. Papers on Mollusks, Harvard Univ. 2:21-135.

he selected as type species, was disregarded after *Planorbina* had come into general use, e. g., by Bryant Walker (1918), Germain (1921), Wenz (1923) and Thiele (1931). Much worse cases of "fit," e.g., *Mesomphix* Rafinesque, have been accepted without question. Such unnecessary changes (*Planorbina* to *Australorbis* to *Biomphalaria* to *Taphius*) in the name of a medically important group give taxonomy a bad reputation.—H. B. B.

ANATOMICAL DIFFERENCES BETWEEN 2 PALEARCTIC SPECIES OF THE GENUS PLANORBIS. By Ja. I. Starobogatov. Zhyr. Akad. Nauk CCCP. (USSR.) *37* (1) : 139-140, 2 figs. 1958.—*P. carinatus* and *P. planorbis* differ in both shells and genitalia. Only shells with a compressed, peripheral carina on the middle of the last whorl belong in the former species.—H. B. B.

ON THE SYSTEMATIC POSITIONS OF 2 FRESHWATER MOLLUSKS FROM THE FAR EAST. By Ja. I. Starobogatov. Zhyr. Akad. Nauk CCCP. (USSR.) *36* (7) : 999-1006. 21 figs. 1957.—Because of pecularities of internal structure, especially of genitalia, *"Glyptophysa" rezvoji* is transferred to *Camptoceras*. *Helicorbis sujfunensis*, described as new, from near Voroshilov (Vladivostok District) had been confused with *Polypylis hemisphaerula*. Dissections of all 3 species are figured. Inclusion of *Intha* and *Pingiella* in the genus *Helicorbis* is proposed.—H. B. B.

EXTINCT OR NEAR EXTINCT COLONIES OF TREE SNAILS, *Liguus fasciatus*, in eastern Broward and northern Dade Counties, Florida. By Frank N. Young. Occ. P. Mus. Zool. Univ. Mich., no. 595, 20 pp., 2 maps. 1958.—Data are given on the distribution of color forms of 2 "subspecies" *L. f. septentrionalis* & *roseatus*. —H. B. B.

PLIOCENE AND PLEISTOCENE SPHAERIIDAE (Pelecypoda) from the central United States. By H. B. Herrington & Dwight W. Taylor. Occ. P. Mus. Zool. Univ. Mich., no. 596, 28 pp., 1 pl. 1958.—This survey includes 2 new species, *S. hibbardi* and *S. lavernense*, from the Lower Pliocene of Oklahoma. Careful drawings would show the characters of the hinge teeth better than even the best photographs.—H. B. B.

Predation of pelecypods and gastropods by *Fasciolaria hunteri* (Perry). By Harry W. Wells. Bull. Marine Sci. Gulf and Caribbean *8* (2) : 152-166. 1 fig. 1958.—This species prefers oyster drills to oysters and an individual may average 5.7 drills per day.—H. B. B.

Feeding habits of *Murex fulvescens.* By Harry W. Wells. Ecology *39* (3) : 556-558. 1958.—This species prefers oysters and, because of its size, is able to pull the valves apart by use of its lip as a brace.—H. B. B.

Marine mollusks from Bougainville and Florida, Solomon Islands. By Alan Solem. Fieldiana: Zoology *39* (20) : 213-226. 1958.—This list of 164 species cites published figures for each, to guard against nomenclatural chaos.—H. B. B.

Marine Ecology. By Hilary B. Moore. 493 pp., many text-figs. John Wiley & Sons. $9.50. 1958.—This careful book should be of great interest and use to all students of marine life. Its approach is principally autecologic, with 3 chapters on environmental factors, 5 on organisms and but 2 on habitats, although those on organisms include habitats which are mainly determined by them, such as coral reefs. The bibliography seems well chosen. However, the lack of a glossary and the absence of some technical terms from the index, may hamper its use as a reference. To some, the foreign spelling of mollusk, and references to *"Purpura" lapillus* will be a trifle confusing.—H B. B.

The marine molluscan fauna of Guadalupe Island, Mexico. A new mollusk from San Felipe, Baja California. By E. P. Chace. Trans. San Diego Soc. Nat. Hist. *12* (19) :319-332, 1 fig. (20):333, 334, fig. 1. 1958.—In the former paper, 77 species are added to make 193 known from the island. *Ocenebra seftoni* is new. In the latter, *Nassarius howardae* is described as new.—H. B. B.

The general histology and topographic microanatomy of *Australorbis glabratus.* By Chia-Tung Pan. Bull. Mus. Comp. Zool. Harvard *119* (3):238-299. 18 pls. 1958.—This histologic

study was carried out as a necessary requisite for subsequent histopathologic investigations on this planorbid. A thorough description of tissues of the organ systems is illustrated by many, quite clear photographs. Comparisons to the known tissues of land snails are made.—H.B.B.

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INFESTATION OF PECTEN IRRADIANS BY POLYDORA[1]

BY HARRY J. TURNER, JR., AND JAMES E. HANKS

A heavy infestation of the spionid polychaete, *Polydora ciliata,* in bay scallops, *Pecten irradians,* in Fairhaven, Massachusetts, is of interest because there appears to be only one previous report of such an occurrence in the literature. In addition the infestation was associated with unusually high mortalities of the scallops and may have been a contributing factor.

The bay scallop, *Pecten irradians,* is of considerable importance to the fall and winter economy of a number of coastal communities in southern Massachusetts. The principal sources of employment in these communities are involved with the summer tourist trade. Consequently the inhabitants depend heavily on fishing and shellfishing during the off seasons to augment their incomes. The scallop crop, which may reach a value of $100,000 or more, is so important that failure of a single generation of scallops can bring about a considerable strain on community welfare budgets. Consequently any factor that may adversely affect the bay scallop population is justifiably viewed with alarm.

At the opening of the scallop season in October, 1958, the shellfish officer of Fairhaven, Massachusetts, discovered that the fishermen were getting an unusually large number of empty scallop shells in their dredges. In addition adductor muscles (the only portion marketed) in the living scallops appeared to be of poor quality. A number of specimens were sent to the authors for study.

Every specimen examined contained the calcified blisters characteristic of *Polydora* along the inside edge of both shells, each associated with a second blister containing fine mud overlain with a thin layer of conchiolin. In addition, many specimens contained one or more large mud blisters around and under the adductor muscle. Worms removed from the blisters were identified as *Polydora ciliata* by Dr. Marian Pettibone, of the University

[1]Contributions number 1002 from the Woods Hole Oceanographic Institution.

of New Hampshire. It was not possible to determine how long this particular generation of scallops had been thus infested because scallop fishing is prohibited before the first of October so that no shells of younger individuals were available. However, the calcification of the blisters near the margins of the shells was so heavy that the worms may have been present for some time. There was no positive proof that the reported heavy mortality had been caused by the worms but the insecure attachment of the adductor muscle caused by the mud blisters in some of the specimens might well cause the muscle to pull loose under violent contraction.

The only previous record of *Polydora* infestations in *Pecten irradians* appears to be that of Plaine (1952) who found a similar occurrence in North Falmouth and Martha's Vineyard Island, Massachusetts. He makes no mention of any unusual mortality or detriment to the scallop. In the oyster, on the other hand, the literature on *Polydora* is extensive. Nelson and Stauber (1940) reported a plague of *P. websteri* in Delaware Bay in which the majority of the worms infested the external surfaces of the oyster shells. In this case, they secreted strands of mucus which entrapped oyster feces and detritus which so covered the oysters that subsequent decomposition brought about an unusual mortality in acres of oyster beds. In a more usual situation described by Lunz (1941), *P. websteri* was reported to get in between the mantle and the shell and to cause the oyster to expend so much energy secreting extra nacre to cover it that the flesh of heavily infested oysters deteriorated. Loosanoff and Engle (1943) reported that vigorous oysters held under optimal conditions in trays showed no apparent ill effects even when heavily infested. In any case, mud blisters may detract from the commercial value because of their unsightly appearance as Needler (1941) pointed out, and Korringa (1952) has stated that European oysters riddled with *Polydora* have brittle shells which break easily during shipment. Complete references to *Polydora* infestations in oysters may be found in Korringa's review (1952).

There have been no reports of injury of the adductor muscles by the blisters of *Polydora*. However, the oyster lays down a massive shell that is continually thickened from the inside. Hence *Polydora* blisters can be so heavily encrusted with nacre as to

maintain a secure muscle attachment. The scallop on the other hand has a thin, delicate shell in which there is little variation in thickness from the hinge to the ventral margin in mature specimens. This seems to indicate that only the margins of the mantle are capable of elaborating nacre in quantity with the remaining area secreting mainly conchiolin when irritated. Thus the scallop may protect itself from *Polydora* infestations near the periphery by walling them off with calcifications but appears to be unable to cope with worms closer to the hinge where they may interfere with the attachment of the adductor muscle.

There seems to be no simple way of eliminating *Polydora* from growing scallops. Korringa (1952) reported success in oysters by placing infected specimens in fresh water for 16 hours or in ½% solution of the ammonium salt of dinitro-orthocresol. The oyster is capable of closing its valves completely and protecting itself for many hours while fresh water or sterilizing solution seeps into the blisters through the communicating pores and kills the worms. The scallop on the other hand cannot close its valves completely and is very sensitive to fresh water and lethal chemicals.

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A NEW OPERCULATE LAND SNAIL FROM HAITI

By OSCAR ALCALDE and MORRIS K. JACOBSON

The genus *Crocidopoma* Shuttleworth 1857, comprises a small number of species of planorbiform operculate land snails that are apparently confined to eastern Cuba and Hispaniola. Bartsch (1942, p. 39) separated the Hispaniolan from the Cuban forms

on the basis of differences in the operculum, confined the true *Crocidopoma* to Hispaniola and erected the subgenus *Cyclocubana* for the Cuban ones. The nature of the operculum of the new species here described tends to support this division. Bartsch (1942) recorded 6 species and 1 subspecies of this genus from Hispaniola, of which 4 were described as new. Thus the present discovery of a new species of this genus in a well travelled and frequently collected area suggests that additional species of these mulch-dwelling mollusks remain to be discovered.

Crocidopoma (Crocidopoma) zayasi, new species Pl. 12, figs. 1, 2

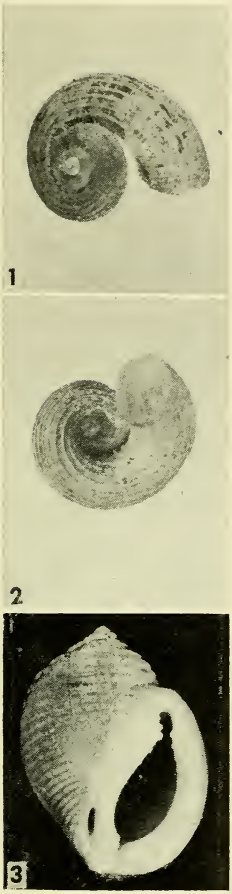
Diagnosis: A cyclophorid of the genus *Crocidopoma* distinguished by a widely solute and sharply descending last whorl.

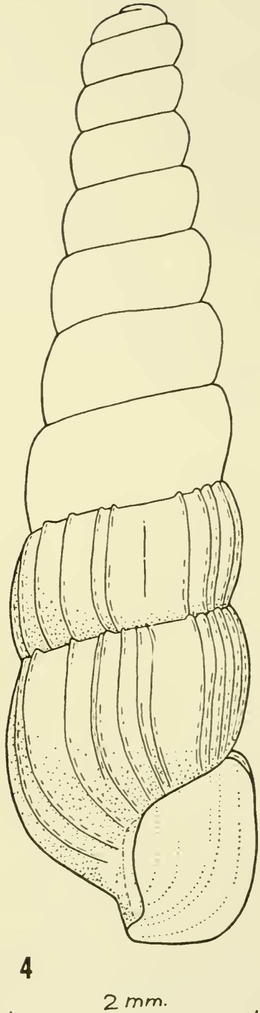
Description: Shell planorbiform, yellowish horn colored, whorls 4½ to 5; aperture circular, very slightly oblique; peristome thin, simple, slightly and regularly distorted by the terminations of the strong spiral cords. Sculpture consists of raised, rounded spiral cords, of which there are 18 to 19 on the last whorl; intercordal spaces almost flat, distinctly wider than the raised cords. The cord at the summit of the body whorl is the strongest, somewhat keel-like. Growth lines distinct, crowded, giving the impression of pseudo-axial striae. Nuclear whorls smooth or minutely, irregularly pitted; post-nuclear whorls marked by the beginning of the spiral cords which grow stronger as they approach the aperture. Suture narrowly but deeply channeled; umbilicus widely open, showing all the whorls. The last whorl of the shell is widely solute and strongly inclined downward, forming an angle of approximately 45 degrees, with the strongly rounded base. Operculum characteristic of the subgenus as defined by Bartsch (1942, p. 39).

Measurements of holotype: Diameter 8.25 mm., height 5 mm., aperture 3.5 mm.

Type locality: Anse a L'Eau, Department du Sud, Haiti, under banana roots in a farm. Collected by Oscar Alcalde Ledon and Fernando de Zayas, July 1951. Holotype in Collection Alcalde, no. 13022. Paratype (figs. 1 and 2) in American Museum of Natural History, no. 79826.

This interesting addition to the *Crocidopoma* of Hispaniola is most closely related to *C. abbotti* Bartsch from the Dominican Republic. It is, however, easily distinguished by the strongly solute and sharply descending last whorl. Although the shell outline is basically planorbiform, the strongly depressed body whorl gives it a false helicoid appearance.





1 & 2, *Crocidopoma zayasi* Alcalde & Jacobson, paratype, approximately × 3. 3, *Oocorys tosaensis*, Habe & Azuma, type, natural size. 4, *Spiraxis splendens* Thompson, type.

It is named in honor of its co-discoverer, Ing. Fernando de Zayas, entomologist in the employ of the Cuban government.

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A NEW SPIRAXIS FROM GUATEMALA

BY FRED G. THOMPSON

Among many minute land snails collected by Paul F. Basch in eastern Guatemala are three specimens of an elegant and undescribed species of *Spiraxis*. Characters of the shell suggest that it belongs in the subgenus *Pseudosubulina*.

SPIRAXIS (PSEUDOSUBULINA) SPLENDENS, new species Pl. 12, fig. 4

Shell turrite, silvery white, translucent, costate; whorls 10⅝, shouldered, slowly increasing in size, with deep, crenulate suture; embryonic whorls 2, first whorl very low and smooth, second whorl much wider; first half turn of embryonic whorls smooth, the following half turn gradually acquiring ribs which become more distinct and continuous with ribbing on following whorls; later whorls quite short, gradually increasing in size, with ribs crested at the suture; ribs continuous across whorls, narrower, and higher near upper suture, but otherwise of equal width throughout their length; first neanic whorl with 46 ribs; fifth whorl with 27; penultimate whorl with 36; surface of whorls with weak striations parallel to ribs; very fine spiral sculpture evident under high magnification; aperture elliptic-trapezoidal; peristome simple, thin, slightly sigmoid; columella slightly sigmoid, truncate, slightly thickened.

Altitude, 7.58 mm.; diameter, 1.96 mm.; altitude last whorl, 1.13 mm.; altitude of aperture, 1.46 mm.; diameter of aperture, 1.12 mm.

Holotype: Univ. Mich. Mus. Zool. 195985; Coban-Sebol Road, 55 miles northeast of Coban, Guatemala; collected by Paul F. Basch, May 6, 1956. Paratypes: UMMZ. 195986 (2); same data as the holotype.

S. splendens resembles *S. irregularis* (Pilsbry) and even more, *S. irregularis negligens* H. B. Baker. It may be distinguished from these two forms by its more slender, less tapering shape. There are also fewer ribs on the last whorl, and the ribs are higher and stronger.

A NEW OOCORYS FROM JAPAN

By TADASHIGE HABE and MASAO AZUMA

About 20 species of the family Oocorythidae had been described hitherto from the deep sea bottom of various parts of the world, and *Galeoocorys leucodoma* (Dall) was the only known species from Japan until today. Recently we fortunately have found the second species from Okezoko in Tosa Bay at about 200 meters in depth.

Oocorys tosaensis, **species nova.** Plate 12, fig. 3

Shell solid and heavy, pale brownish white, ovate; whorls about 5; spire low and body whorl very large, occupying 5/6 of the shell length; each whorl marked off by a distinctly canaliculate suture; surface coarsely sculptured with spiral cords, of which the body whorl has 23. Aperture elongate oval, but constricted near posterior end; outer (palatal) lip very much thickened and reflected backwards with a deep sulcus behind it; the inner side of the outer lip with many sulci which run inwardly a short distance from the edge; the lowest sulcus developed as a large nodule; inner (parietal) lip with a heavy callus, which is marked at its edge with many ridges, which are best developed towards the posterior end; siphonal canal short, but well developed and set obliquely; anal canal also short and well developed. Umbilicus narrowly but distinctly perforate.

Length: 32.0 mm. and breadth 24.2 mm. (Type specimen; Amakusa Marine Biol. Lab., type no. 293).

Type locality: Okezoko in Tosa Bay, Shikoku, Japan; about 200 meters in depth.

This new, rare species is very well characterized by its umbilicate shell, which differentiates it from all known species of the genus *Oocorys*.

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NOTES ON THE CROWN CONCH, MELONGENA CORONA

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Studies were begun in late November, 1954, to determine the rate of growth of the crown conch, *Melongena corona* (Gmelin), at Cedar Key, Levy County, Florida. Gunter and Menzel (1957) noted that there is disagreement as to the use of subspecific names for this species of mollusk but following Clench and Turner (1956) the Cedar Key population would be identified as *M. c. corona* (Gmelin).

The growth study was first attempted by the method outlined by Lenderking (1952) for a study on *Littorina angulifera* (Lam.) in south Florida. This consists of notching the lip of the shell with a triangular file, returning the mollusk to the oyster bar, and on recovering it later and noting the growth on the lip beyond the notch, calculating back to determine its original size (height)—thus by simple subtraction determining the increase in height of the shell. Although a number of the Cedar Key *Melongena* were recovered, and a number of the notches were filling in, leaving an obvious scar, only 3 of the smaller individuals showed any lip growth so that when circumstances forced the discontinuance of the project in late October, 1955, this phase of the growth study was abandoned.

Two large samples were collected, on May 29 and October 22, 1955, and measured in an effort to study growth by comparing modes of length-frequency curves. This method was also discontinued as the modes for the two samples were so similar that no growth could be ascertained. The individuals sampled during the study ranged from 42 to 110 mm. in greatest height of the shell. There was a single mode at approximately 75 mm. in each sample. Hathaway (1957) found that only the larger individuals of *Melongena* occurred on the oyster bars (where my entire study was conducted). Since I also found only large individuals, the failure of both growth studies may have been due to my dealing with only adult or sub-adult individuals at, or nearing, their maximum size and exhibiting at most very slow growth. Although no significant findings were made on rate of growth, the conchs collected in November, December, and January had hard lips, while many of the smaller conchs collected in the late spring

(April and May) had very soft lips, indicating, as would be expected, that growth occurred during the warm months.

Despite the failure to establish growth rates, a number of natural history notes were obtained that seem worthy of presentation here. The most significant of these relate to the year-round presence and the movements of these animals.

Although the markings were such that individuals could not be recognized (unless they were recaptured and subsequently released again), each sample had the lips of the shells notched in a different position so that an individual could be recognized as having been marked and released with a given sample.

On November 27, 1954, 30 specimens were captured, marked by notching the middle of the lip, and released at one spot (about 2 feet in diameter) on a small intertidal oyster bar near the shore at the end of the airstrip on Way Key, Cedar Keys. On December 3, 1954, 49 more were similarly captured, marked, and released at the same point. The dates were so close, and the bar on which they were collected so small, that these two samples were considered as one.

On January 8, 1955, 107 individuals were marked by notching the upper part of the lip and were released in the same spot as those of the first sample. Again, all had been captured on this same bar.

On April 17, 1955, 307 mollusks were marked by notching the lower part of the lip. In this instance, the individuals were collected on the original bar and on a smaller bar between it and the shore. All were released at the same spot as the other samples.

Collections were made on May 29 and October 22 in an effort to recover individuals showing growth, but no further marking was done.

Each of the collections subsequent to the original marking on November 27 yielded marked individuals. The following is a summary of these recaptures.

In this summary, the date or dates of release are given first, followed by the date of recapture, the number of days at liberty, and the minimum distance traveled:

XI-27-54 to XII-3-54, 7 days, 20^1 feet; XI-27-54 and XII-3-54 to I-8-55, 29 or 36 days, 3, 5, 6, 7, 8^2, 15, 21^1, and 66 feet; XI-27-54 and XII-3-54 to IV-17-55, 128 or 135 days, 22, 26, 29^2, 43, 97, 105,

132, and 139 feet; I-8-55 to IV-17-55, 99 days, 2, 3, 4, 4, 8, 13, 16, 22, 33, 42, 42, 43, 65, 128, 143, and 157 feet; XI-27-54 and XII-3-54 to V-29-55, 170 or 177 days, 6, 13, 16, 19, 21, 24, 26, 29, 31, 32, 33, 51, 88, 98, 98, and 142 feet; I-8-55 to V-29-55, 141 days, 20, 26, 27, 29, 31, 36, 50, 70, 119, and 141 feet; IV-17-55 to V-29-55, 46 days, 1, 3, 4, 26, 34, 48, 50, 62, 64, 71, 75, 96, 138, 139, and 161 feet; XI-29-54 and XII-3-54 to X-22-55, 316 or 323 days, 1, 7, 45, 75, 98, 105, 131 and 249 feet; I-8-55 to X-22-55, 289 days, 3, 96, 99, 102, 108, 112, and 231 feet; IV-17-55 to X-22-55, 194 days, 3, 37, 85, and 237 feet.

While the paths could not be ascertained, they probably followed as close to the oyster bars as possible, since few individuals were found off the bars, and these were in close proximity to the oysters. The bar on which the conchs were released was approximately an oval about 100 by 40 feet and located about 50 feet from shore. There were no other bars for several hundred feet in one direction along-shore or offshore, but there were a number of bars in the opposite direction along the shore. The release bar was thus the last of a series of small along-shore bars, just off the shore. The pattern of bars was not in a straight line, parallel to the shore, but rather the bars were quite irregularly placed, actually touching the shore in some places. The distances between bars were 10 feet or less, so that the conchs would not have to travel long distances over open sand (submerged or not—depending on the tide stage) in getting from bar to bar. In this regard, I rarely obtained a specimen of *Melongena* in some 25 trawling collecting trips to deep and shallow flats, in channels, and on channel edges (all these stations away from oyster bars) made in connection with a fish study at Cedar Key conducted from February, 1953, through April, 1954 (for a detailed description of these habitats, see Caldwell, 1957).

The distances traveled, as given in the above summary, are straight lines, determined by pacing in a direct course between the points of capture and release. They are minimal, as the animals may have meandered considerably as well as traveled curved routes. The longer distances necessarily are over routes which include one or more oyster bars in addition to the original release bar. Oyster bars more than 250 feet from the original

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[1] Same individual recaptured twice; movement in diametrically opposite directions.

[2] Same individual recaptured twice; movement in diametrically opposite directions.

point of release were not visited, and probably some snails had moved even futher than indicated in the summary. The most distant bars were visited only late in the study, and hence longer distances could have been traversed by the mollusks earlier in the study, and they would not have been recorded.

Evidently from the data presented in the summary, movement is random, and there is no apparent relationship between time and distance traveled. Although no records of size were kept, there appeared to be no correlation between the size of the individuals and the distance traveled, although the larger individuals were found lower on the bar. Nor was there any tendency to stay together in groups; that is, two individuals at liberty 10 days and moving 10 feet were not necessarily together at the end of the period, since, though some *were* near to one another, the 10 feet moved was just as often in opposite directions from the release point. That some individuals were only a few feet away from the release point after nearly a year may mean that they had not moved, but more likely they had moved away and in their random movements over the bar were, by chance, back on that part of the bar when recaptured—perhaps having moved back and forth over the point (and far beyond) a number of times during the year.

As each marked individual was recaptured, it was marked a second time by code-notching the bases of the prominent spines of the shell. The fact that only two individuals so marked were recaptured a second time, and none more than twice, indicates that there must be considerable movement away from the bars and out of the collection zone. Conversely, the large number of unmarked snails collected at each sampling indicates either a great influx of individuals to those bars under study, or excellent camouflage. While camouflage is almost certainly a factor in accounting for so many unmarked snails, so much effort was expended in trying to find all snails that immigration, as corroborated by the marking results, seems the more tenable. Dead shells were always examined for marks, but none of those collected had been notched. Actually, relatively few such shells were seen and the primary predators on the crown conchs at Cedar Key may employ methods which either crush the shell so badly that it would not have been examined or carry the snail

away from the bar to be consumed.

No egg cases were seen, but copulating pairs, with the male considerably smaller in each case, were observed on the oyster bars in April and May.

Gunter and Menzel (1957:85) noted that on some reefs north of Cedar Key in the Gulf of Mexico (in Apalachicola Bay) *Melongena* were absent in winter, where they had been in the fall. From my findings at Cedar Key, more probably the crown conchs, although capable of movement, were buried, or partially buried, in the mud on or adjacent to the reefs, and because of excellent camouflage were not readily seen. At Cedar Key an effort was made to collect for marking every living *Melongena.* Some were taken at every collection: 30 on November 27, 50 on December 3, 1115 on January 8, 331 on April 17, 269 on May 29, and 238 on October 22. Since about the same collecting effort was expended each time, or actually even less in summer because the mollusks were easier to find, a trend is thus indicated toward scarcity in winter and abundance in summer on the oyster bars, but never complete absence. The increased number collected in the winter month of January was probably due to an immediately previous, extended warm period of about 3 weeks, and lends further evidence to the continuous presence of the conchs on the bar and the conclusion that they bury in cold weather.

Gunter and Menzel (1957) and Menzel and Nichy (1958) have discussed *Melongena corona* in relation to its predation on oysters. While I found a few crown conchs feeding on oysters, feeding was so occasional in relation to the number of conchs found that this predator probably is not a major one, as noted by these writers, except, as pointed out by Clench and Turner (1956:161), where by sheer numbers it may be a menace.

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LAND SNAILS OF CARROLL COUNTY, MARYLAND

By WAYNE GRIMM

Carroll County is located in the piedmont region of north central Maryland, and covers an area of 456 square miles. It is bounded on the west by Frederick County, on the south by Howard County, on the east by Baltimore County, and on the north by York County and Adams County, Pennsylvania. The average elevation is about 750 feet, the highest point on Parr's Ridge being 1,100 feet and the lowest in the Patapsco Valley being about 400 feet. In general appearance the countryside is quite hilly, with large, rolling mounds extending from northeast to southwest. The land is drained by tributaries of the Patapsco, Monocacy, and Gunpowder Rivers.

Parr's Ridge forms the backbone of the county and divides the drainage of the Monocacy from the drainages of the Patapsco and the Gunpowder. Hills radiate from it and slope gently down to the valleys of these rivers.

Geologically the land is quite variable. Triassic red shales and sandstones dominate the northwestern section of the county, with incursions of granite, schist, and marble. The greater part of the county is dominated by schist, with major incursions of the above mentioned rocks.

Mean annual precipitation is about 44 inches, spring being the wettest season. Often there is very little rain in late summer and early autumn. The mean annual temperature is about 52 degrees, and the growing season lasts approximately 160 days.

With the exception of widely scattered patches of thin deciduous forest, the entire county has been cultivated extensively. However, excellent habitats for land snails are furnished by numerous railroad cuts and quarries, in which discarded ties, loose rocks, and thick underbrush provide shelter. During the years 1955 to 1958, the majority of my collecting was done in such places.

A total of 37 species of land snails were found, many of them abundant at seemingly barren and unproductive stations. The destruction of the forest has contributed many new habitats to the general picture, providing environments not often found in nature. In this manner, agriculture has been a serious factor in limiting the distribution of such forest species as *Haplotrema concavum* and the philomycid slugs. Numerous others, however, have adapted themselves to the secondary conditions.

Locality Records

Stenotrema hirsutum (Say): Quarry on Route 31 between Westminster and New Windsor. Marble quarry south of Westminster on Route 27; Shervette's Corner on Route 26. Woods near Patapsco on Route 90.

Mesodon thyroidus (Say): Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg. Quarry on Route 31 between Westminster and New Windsor. Railroad tracks at New Windsor. Ruins of building on Route 30 at Hampstead. Quarry south of Westminster on Route 27. Railroad tracks at Mt. Airy. Shervette's Corner on Route 26. Woods near Patapsco on Route 90.

Triodopsis juxtidens (Pils.): Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg (albinistic specimens). Railroad tracks at Lineboro on Route 86. Woods near Patapsco on Route 90. Woods near Monocacy River off Keysville Road.

Triodopsis fallax (Say): Railroad tracks at Lineboro on Route 86. Off Route 97 between Taneytown and Monocacy River.

Triodopsis albolabris (Say): Woods along Route 31 north of Westminster.

Cecilioides acicula (Müll.): Under debris near railroad tracks at bridge, Westminster.

Haplotrema concavum (Say): Quarry on Route 31 between Westminster and New Windsor. Marble quarry south of Westminster on Route 27. Woods near Patapsco on Route 90.

Oxychilus draparnaldi (Beck): Under debris near railroad tracks at bridge, Westminster. Near railroad tracks at Union Bridge.

Retinella burringtoni (Pils.): Woods beside Kay's Mill Road near Route 91 near Finksburg. Quarry on Route 31 between Westminster and New Windsor.

Retinella rhoadsi (Pils.): In leaf litter along railroad tracks at Mt. Airy. Marble quarry south of Westminster on Route 27.

Retinella indentata (Say): Quarry on Route 31 between Westminster and New Windsor. Railroad track at New Windsor. Railroad tracks at Lineboro on Route 86. Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg. Under pieces of wood and wet sandstone in field at Taneytown. Woods near Patapsco on Route 90.

Hawaiia minuscula (Binney): In leaf litter along railroad tracks at Mt. Airy. Railroad tracks at New Windsor. Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg. Railroad tracks at Lineboro on Route 86. Under debris near railroad tracks at bridge, Westminster. Under wet sandstone, field at Taneytown.

Ventridens suppressus (Say): In leaf litter along railroad tracks at Mt. Airy. Railroad tracks at New Windsor. Railroad tracks at Lineboro on Route 86. Woods off Kay's Mill Road off Route 91 near Finksburg. Marble quarry south of Westminster on Route 27. Quarry on Route 31 between Westminster and New Windsor. Ruins of building on Route 30 at Hampstead. Woods near Patapsco on Route 90.

Ventridens ligera (Say): Under wet sandstone, field at Taneytown. Quarry on Route 31 between Westminster and New Windsor. Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg. Off Route 97 between Taneytown and Monocacy River. Near railroad tracks at Union Bridge.

Zonitoides arboreus (Say): In leaf litter along railroad tracks at Mt. Airy. Railroad tracks at Westminster. Ruins of building on Route 30 at Hampstead. Railroad tracks at New Windsor. Quarry on Route 31 between Westminster and New Windsor. Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg. Woods near Monocacy River off

Keysville Road. Shervette's Corner on Route 26. Woods near Patapsco on Route 90.

Deroceras reticulatum (Müll.) : Railroad tracks at Lineboro on Route 86. New Windsor railroad tracks. Near railroad tracks at Union Bridge.

Deroceras laeve (Müll.): New Windsor railroad tracks. Near railroad tracks at Cedarhurst.

Limax maximus L.: Near railroad tracks at Taneytown.

Discus cronkhitei (Newc.) : Under debris near railroad tracks at bridge, Westminster. Ruins of building on Route 30 at Hampstead. Railroad tracks at Lineboro on Route 86. Railroad tracks at New Windsor. Quarry on Route 31 between Westminster and New Windsor. Under dead wood near marble quarries south of Westminster on Route 27. Leaf litter near railroad tracks at Mt. Airy. Under wet sandstone and pieces of wood in field at Taneytown. Railroad tracks at Millers, on the road to Alesia.

Helicodiscus parallelus (Say) : Quarry on Route 31 between Westminster and New Windsor. Railroad tracks at Lineboro on Route 86. Off Route 97 between Taneytown and Monocacy River. Leaf litter along railroad tracks at Mt. Airy. Ruins of old building on Route 30 at Hampstead. Under debris near railroad tracks at bridge, Westminster. Woods near Monocacy River off Keysville Road.

Helicodiscus singleyanus (Pils.): Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg. Ruins of building on Route 30 at Hampstead. Quarry on Route 31 between Westminster and New Windsor.

Punctum minutissimum (Lea): Woods beside Kay's Mill Road off Route 91 near Finksburg (in leaf mould). Woods near Patapsco on Route 90.

Pallifera dorsalis (Binney) : Shervette's Corner on Route 26. Woods at Patapsco on Route 90.

Philomycus flexuolaris Raf.: Woods near Monocacy River off Keysville Road. Woods at Patapsco on Route 90.

Succinea avara Say: Leaf litter in low area near railroad tracks at Mt. Airy. Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg.

Gastrocopta armifera (Say) : Under debris near railroad tracks at bridge, Westminster. Leaf litter along railroad track at Mt. Airy. Railroad tracks at Lineboro on Route 86. Railroad tracks at New Windsor. Ruins of building on Route 30 at Hampstead. Quarry on Route 31 between Westminster and New Windsor. Marble quarry south of Westminster on Route 27. Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg.

Gastrocopta contracta (Say) : Ruins of building on Route 30 at

Hampstead. Railroad tracks at New Windsor. Railroad tracks at Lineboro on Route 86. Field at Taneytown. Leaf litter along railroad tracks at Mt. Airy. Quarry on Route 31 between Westminster and New Windsor.

Pupoides albilabris (C.B.Ad.) : Railroad tracks at Lineboro on Route 86. Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg. Railroad tracks at New Windsor. Railroad tracks at Cedarhurst. Near railroad tracks at Union Bridge.

Pupilla muscorum (L.) : Under debris near railroad tracks at bridge, Westminster. Railroad tracks at New Windsor. Near railroad tracks at Union Bridge.

Vertigo tridentata Wolf: Quarry on Route 31 between Westminster and New Windsor. Ruins of building on Route 30 at Hampstead.

Vertigo pygmaea (Drap.): Field at Taneytown. Near railroad tracks at bridge, Westminster.

Vertigo ventricosa (Morse): Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg. Field at Taneytown.

Columella edentula (Drap.): Under stone, marble quarry south of Westminster on Route 27.

Vallonia pulchella (Müll.) : Field at Taneytown. Railroad tracks at New Windsor. Railroad tracks at Mt. Airy. Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg. Marble quarry south of Westminster on Route 27. Railroad tracks at bridge, Westminster.

Vallonia excentrica Sterki: Railroad tracks at Lineboro on Route 86.

Vallonia costata (Müll.) : Around foundation of old burned house, Kay's Mill Road off Route 91 near Finksburg. Marble quarry south of Westminster on Route 27. Railroad tracks at Lineboro on Route 86. Quarry on Route 31 between Westminster and New Windsor. Railroad tracks at bridge, Westminster. Railroad tracks at New Windsor. Near railroad tracks at Union Bridge.

Cionella lubrica (Müll.) : Railroad tracks at New Windsor. Field at Taneytown. Railroad tracks at bridge, Westminster. Leaf litter along railroad tracks at Mt. Airy. Ruins of building on Route 30 at Hampstead. Railroad tracks at Lineboro on Route 86. Near railroad tracks at Union Bridge.

The occurrence of *Pupilla muscorum* in Carroll County is rather unusual, for its general range is far to the northward. It is quite abundant in open situations in Frederick County. Importation seems likely. To my knowledge, neither *Cecilioides*

acicula nor *Columella edentula* have been found previously in Maryland.

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RANGE EXTENSIONS OF SOME WEST N. A. MARINES

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During an extended search for additional specimens of a presumably new species of *Astraea* brought in by a SCUBA. diver of the Scripps Institution of Oceanography in La Jolla, California, several minor range extensions of well known California mollusks were noted. In addition at least two major range extensions were observed. The former will not be listed here but the latter will be discussed below. Concurrently with the search alluded to above, there were made several intertidal collecting trips, one of which yielded a rather surprising range extension, while still another startling range extension was discovered with an experimental SCUBA. diver.

ACMAEA FUNICULATA (Carpenter).

This elegant species has been obtained by dredging in small numbers from a variety of localities, mostly in the region near the Santa Barbara Channel Islands. The range is given in Keen's "Abridged Check List of West North American Marine Mollusca" from 34° to 37° North Latitude. On July 19, 1957, a group of Scuba divers (consisting of Dr. E. W. Fager, R. Ghelardi, J. Stewart and W. Clarke, all from Scripps Institution) obtained this species in approximately 150 feet of the seaward side of the northern island of Los Coronados, some miles south of San Diego; this locality is at approximately 32° 27′ N. Altogether 42 specimens were brought up, and the divers reported that the rocks and large boulders were covered with these animals. On July 26, 1957, during four successive dives to a submarine rock plateau, the same divers, joined by two others (H. Scotten and C. D. Jennings, also from Scripps Institution) brought up a total of 173 specimens. This rock plateau is situated about 8 miles south of

the South Coronado Island at about 32° 17′ 30″ N. and all specimens were collected at a depth of from 90 to 120 feet.

ACMAEA MITRA Eschscholtz.

This is a fairly common limpet in the lower intertidal region of northern and central California. Keen (loc. cit.) gives the range of this species as from 34° to 56° North Latitude. In the search alluded to above this species was found in many places; the divers participating were the same as those already listed. While 138 specimens were collected, they are distributed over 18 separate lots (with a minimum of one and a maximum of 29 specimens) from localities between Point Loma in San Diego County (32° 42′ 30″ N.) to off Santa Tomas, Lower California, Mexico (31° 35′ N.). Depths at which these animals were collected range from about 40 feet to 150 feet. In all cases the bottom was described by the divers as rocky or as consisting of rock ledges and boulders. As may be worth noting, *A. funiculata* was more abundant in this general area than *A. mitra,* which might be interpreted as an indication that the former species should be found even further south while the latter appears to be very close, if not at, its southern range limit.

ACMAEA FENESTRATA CRIBRARIA Carpenter.

This subspecies is generally considered to be limited in its distribution to an area starting just north of the town of Cayucos, San Luis Obispo County; as has been stated, any *Acmaea fenestrata* from south of the town is the other subspecies, i. e. *A. f. fenestrata* (Reeve). Thus the southern boundary of the range of *A. f. cribraria* was considered to be about 35° 25′ North Latitude. On July 27 and 28, 1957, the writer in company with Mr. and Mrs. C. D. Jennings and Mr. and Mrs. A. H. Wolfson, collected in the intertidal region of two places in Lower California. As best as can be ascertained the two localities are at 32° 05′ (where 3 specimens were obtained) and 32° 07′ N. (where 2 specimens were collected); as seems worth mentioning, however, the water in both these areas was "unusually" cold (no thermometer being available, temperatures were noted only subjectively) which might indicate that the *Acmaea f. cribraria* was in an area of a cold upwelling.

Neosimnia quaylei (Lowe).

This species was described from San Felipe, Baja California, Mexico, in the Gulf of California, where it was found at extreme low tide. As far as this writer is aware, *N. quaylei* has not been reported except from the type locality. On January 3, 1958, three of the most experienced SCUBA. divers from Scripps Institution made an experimental dive to a depth of 250 feet due west off Scripps' Pier in La Jolla. Mr. Conrad Limbaugh, Marine Diving Specialist, brought up from that depth 1 *Acteocina culcitella intermedia* Willett, 2 *Megasurcula c. carpenteriana* (Gabb), 1 (dead) *Mytilus edulis diegensis* Coe, 1 (dead) *Nemocardium centifilosum* (Carpenter) and 2 *Neosimnia quaylei* (Lowe). This appears to be the first report of *Neosimnia quaylei* being taken alive in California waters and not in the Gulf. While the range extension northward is but approximately two degrees of latitude (San Felipe: ca. 31° 03′ N.; Scripps' Pier: ca. 32° 52′ N.), it is nevertheless the largest range extension noted in this paper. The two localities are separated from each other by a land mass of approximately 130 miles (by air) but following the coast of Lower California down the Gulf and around Cape San Lucas, the distance is a trifle more than a total of 1,200 miles.

Sanguinolaria nuttallii Conrad.

Smith and Gordon (1948) in their paper on the mollusks of Monterey Bay list this species on page 176 as from Elkhorn Slough; they further indicate that it occurs in mud and is rare. Fitch (1953) states that this species attains a length of 4 inches. On April 23, 1955, Dr. C. Hand collected one living specimen of this species at low tide in Bodega Harbor, Sonoma County (approximately 38° 18′ 50″ N.); it measures 72 mm. or 2¾ inches. This is apparently the only specimen on record from that northern locality. However, on October 6, 1958, a group of divers including D. and E. Isaac of the Zoölogy Department of the University of California in Berkeley, were exploring the bottom of Tomales Bay about ½ mile inside its mouth (ca. 38° 14′ 15″ N.); their aim was to discover sand dollar beds. A motorboat, from which the dives were made, in an attempt to cross the Bay got stuck on a sand bar and the efforts to free the boat led to the discovery of a large bed of *S. nuttallii.* The churning of the

motor uncovered a group estimated at between 60 and 100 individuals of this species in an area which at low tide was still under a little more than two feet of water. The largest individual picked up measures 126 mm. (or 5 in.) while none of those brought in measures less than 112 mm. (or 4½ in.). The unusual size of these clams may be due to the fact that they occurred in an area not accessible to the ordinary clam digger; the Isaacs, though not equipped with SCUBA., nevertheless made use of face plate and snorkel when diving for the animals.

With one exception, the foregoing list of range extensions is based entirely on results of exploring deeper waters with the aid of SCUBA. or (in one instance) simple skin diving. It may be anticipated that, with further application of SCUBA. diving, many interesting range extensions will be discovered, especially of species that normally cling tightly to the substrate when stimulated and favor large rocks for their home. Such species have not been obtained by ordinary dredging methods for obvious reasons.

All specimens discussed or mentioned in this article are deposited in the study collections of the Department of Zoölogy of the University of California in Berkeley.

The following table summarizes the range extensions noted here.

Species	"Old" range	"New" range	Range extension in degrees lat.
Acmaea funiculata	34° to 37°	32° to 37°	2° southward
A. mitra	34° to 56°	32° to 56°	2° southward
A. fenestrata cribraria	35° to 57°	32° to 57°	3° southward
Neosimnia quaylei	31°	31° to 33°	2° northward
Sanguinolaria nuttallii	25° to 37°	25° to 38°	1° northward

Note: the "old" ranges are taken from Keen (loc. cit.) except for the record of *Neosimnia quaylei;* in stating the "new" ranges the same procedure as that applied by Keen was employed, i. e. rounding off to the next nearest degree latitude.

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SELF-FERTILIZATION AND PRODUCTION OF YOUNG IN A SPHAERIID CLAM*

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Many freshwater mollusks are hermaphroditic, although most of them tend to cross-fertilize. However, certain species of *Physa* and *Lymnaea* are known to produce viable, diploid eggs without copulation, and isolated individuals have successfully produced young in the laboratory. DeWitt (1954) reported securing eggs that hatched from an isolated F_2 generation of *Physa gyrina*: Colton (1918) reared 47 generations of *Lymnaea columella* under similar conditions, and Crabb (1927) clearly indicated that *Lymnaea stagnalis appressa* reproduces by self-fertilization. Studies of freshwater mussels revealed that certain specimens of *Anodonta imbecillis* (Sterki 1898, Ortmann 1919), *Anodonta grandis* (van der Schalie and Locke, 1941), and *Carunculina parva* (Tepe, 1943) contain ripe eggs and sperm at the same time. Bloomer (1942) concluded that *Anodonta cygnea* was capable of self-fertilization but that without extensive growth experiments with young animals it would be hard to prove whether or not this is the usual practice in nature.

Members of the family Sphaeriidae are both hermaphroditic and viviparous. They have separate ovaries and testes with a common duct opening into the cloacal chamber. There is general agreement among a number of workers on the morphology of the reproductive system, but disagreement both as to where fertilization takes place, and the source of the sperm. Stepanoff (1865) stated that the mature eggs fall into the common gonadal duct and become surrounded by sperm, and he assumed that fertilization takes place there. Gilmore (1917) simply pointed out that ripe sperm and eggs are found at the same time in a single animal. Woods (1931) agreed with the latter statement, but asserted that this observation is not in itself positive evidence

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* This work is a portion of a thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the University of Michigan, Ann Arbor, Michigan. The author wishes to acknowledge the help of members of her committee, particularly that of the chairman, Dr. Frank E. Eggleton. Thanks are also due to Dr. Robert M. DeWitt for helpful suggestions and comments, and to Rev. H. B. Herrington for identification of the specimens.

of self-fertilization. His attempts to answer this question were unsuccessful because of culturing difficulties. Okada (1935b) declared that in *Musculium heterodon,* eggs in the upper part of the common gonadal duct show no signs of sperm penetration nor are they surrounded by sperm, while near the urogenital orifice (the opening of the common duct into the cloacal chamber) they are fertilized. He pointed out that possibly sperm from other animals may enter the common gonadal duct with the inhalent current and surround the eggs as they come down the duct. Therefore, he was uncertain whether self-fertilization actually occurred.

In an effort to cast some light on this problem, Odhner (1951) isolated some specimens of *Pisidium conventus* in small aquaria and isolated their young in turn. From the latter, he secured fry which constituted the true laboratory-born generation. He thus concluded that this species is autogamic. The present study was undertaken to secure more evidence bearing on this problem.

Self-fertilization in laboratory cultures: Sphaerium (Musculium) partumeium (Say) is a clam which is very abundant in the bottom mud of small ponds, where it grows to a maximum length of about 9.0 millimeters. The specimens for this study were collected from a temporary pond known as Kenk #II (Kenk, 1949), located 8 miles southeast of Ann Arbor, Michigan. The clams were brought into the laboratory in samples of bottom mud, carefully separated from the mud and plant material, and placed in culture dishes until they produced young. Their young were considered to be the parent stock of the laboratory-born generations. As soon as an animal was born, it was placed in a separate culture dish and maintained there for the rest of its life. (Thomas, 1954). When these specimens gave birth to young, the latter in turn were again promptly isolated.

The shells were measured in length, the distance from extreme anterior to posterior margins, and height, the distance from the umbones to the ventral edge. Because of the small size and the fragile nature of the shells, measurements were made with an ocular micrometer.

Within 15 months of the beginning of the culture work, 6 laboratory-born generations had been secured from one fast-growing stock, while 3 and 4 generations were produced in others.

The animals producing the most generations in that time were the ones in which the initial growth was rapid, that is, showed little lag at the beginning. Growth of these animals will be discussed in a later paper.

TABLE 1

Data on Six Laboratory-born Generations

Clam Number	Size at Birth	Final Size	Number of Young	Mean Size of Young Produced
IL25	1.34 by 1.01	6.77 by 5.85	21	1.38 by 1.06
IL102	1.46 by 1.20	6.92 by 6.00	10	1.62 by 1.26
IL208	1.73 by 1.34	4.93 by 4.15	4	1.44 by 1.11
IL263	1.29 by 1.01	5.15 by 4.46	13	1.34 by 1.01
IL270	1.39 by 1.05	4.93 by 4.15	4	1.36 by 1.00
IL274	1.65 by 1.29			

TABLE 2

Data on Other Third, Fourth, and Fifth Generation Laboratory-reared Specimens

Clam Number	Generation Number	Final Size	Number of Young	Mean Size of Young Produced
IL192	3	6.46 by 5.38	10	1.39 by 1.07
IL225	3	5.76 by 4.92	10	1.39 by 1.07
IL257	3	7.00 by 6.15	21	1.54 by 1.21
IL264	4	7.37 by 6.20	13	1.63 by 1.28
IL265	4	6.38 by 5.54	11	1.60 by 1.24
IL269	5	4.31 by 6.15	21	1.54 by 1.21

Table 1 lists pertinent data for individuals representing the 6 generations of one laboratory-born clone. Each clam is the offspring of the one listed on the line above it, and a descendant of IL25 which was born and isolated on November 21, 1953. As can be seen, IL270 was larger at birth than IL25, and the mean dimensions of their young are very nearly the same. Although the

former produced a larger number of offspring than any of its descendants, the number (21) is well above the mean (10), and table 2 lists a third generation specimen which was just as prolific. Although there would seem at first glance to be a downward trend in final size, the unrelated specimens in table 2 include third and fourth generation clams which attained a length of 7 mm. or more. Successive generations raised in isolation thus exhibited no reduction in either the average sizes at birth or in final size, no change in total number of young produced, nor was there any change in activity or increase in early mortality.

Sectioned specimens showed that, although ovary and testis are present at birth, neither organ contains mature reproductive cells. Ripe eggs and sperm do not appear until the animals are at least 2.1 mm. in length. Hence, fertilization cannot take place before birth. Since the young were well below the minimum size for sexual maturity when they were isolated, self-fertilization must have taken place. Thus *Sphaerium partumeium* is capable of reproducing by this means. Probably, since these animals are so successful in producing young in this way in the laboratory, their eggs may be self-fertilized, at least part of the time, in their natural habitat. If this ability is general among the fingernail clams, their wide dispersal in the field may not be hard to explain. As Odhner has pointed out: ". . . only a single specimen carried by a bird, a beetle or a fish to another locality is sufficient to create a whole population."

Young Produced in Laboratory Cultures: It has already been mentioned that the sphaeriids are viviparous. Fertilized eggs, in some manner, reach the branchial chambers of the inner gills, and there become enclosed in brood pouches. The outer layer of these pouches is derived from the gill lamellae and the inner layer from maternal blood corpuscles (Okada, 1934, 1935a). The large cells of the inner layer are believed to be used up in the nourishment of the embryos. The wall of the branchial chamber itself is lined with the same sort of cells, and is used as food by the extra-marsupial embryos which are large enough to have escaped from the sacs but which are retained within the chamber. Although the study of early embryology is beyond the scope of this paper, general observations on serial sections of *Sphaerium*

partumeium support Okada's findings in his work on *Musculium heterodon.*

The extra-marsupial young can be seen through the thin shells of adult animals. When the embryos are large enough to be born, they are often very active. They extend the foot and travel around within the branchial chamber, finally reaching the cloacal chamber. From there they leave the parent through the excurrent siphon and, dropping to the bottom of the dish, continue their movements. In every case of birth observed among laboratory animals, the parent lay on one side with shell valves and mantle open, but other behavior patterns varied with the individual. Some animals had foot and siphons retracted and seemed to contribute no effort at all to the expulsion of the young. Their young literally "walked out" through the siphon all by themselves. Other parents extended foot and siphons, and forced the offspring out by contractions of these parts. Their young were forcibly ejected with a fast-moving stream from the excurrent siphon. Occasionally, in spite of the efforts of both participants, the fry could not be dislodged, and the parent continued the violent muscular exertion at intervals for hours.

The clams born of the laboratory stock ranged in size from 1.85 by 1.49 to 0.93 by 0.72 mm. Although a number of specimens in the lower part of this range were isolated and fed, the smallest to be successfully raised was one which measured 1.25 by 0.985 mm. The others either died within a few days or remained alive without growing for a period of several weeks. This length difference of 0.6 mm. between the largest and smallest viable young is considerable in relation to the actual size. The 1.25 mm. individual is only two-thirds as long as the other. This observation leads to the supposition, which is supported by other data, that the fully formed and viable young may be retained by the parent for variable periods of time.

There was little correlation between the size or age of the adults at the time of any particular birth and the size of the young they produced. The offspring of certain clams were remarkably homogeneous with respect to size at birth, but in other cases the variation might be as great as 0.8 mm. in length. The first offspring produced by 40 of the 60 adults included in the study, were below the mean in length, and statistical tests showed

that the first young are significantly smaller than the other offspring. The mean birth size of 547 laboratory specimens was 1.44 by 1.22 mm. Most of the animals attaining the greatest final size and also bearing the largest numbers of young were above the mean at birth. One notable exception, however, was the 1.25 mm. individual previously mentioned which produced a total of 24 offspring; it measured 6.92 by 6.0 mm. at the time of death.

The laboratory animals usually began producing offspring between their 8th and 13th week. However, several rapidly growing clams started at the end of seven weeks. The mean size of 60 adults, when bearing their first young, was 4.54 by 3.92 mm. Far below that mean was one specimen measuring 3.70 by 3.31 mm. which produced an offspring one-third its own length (1.25 by 0.96 mm.), and at the other extreme was a clam which reached a length of 6.46 mm. before bearing any young. The mean number of offspring was 10: the range, from 2 to 30. Production of young was continued until the death of the parent.

Young Produced in Field Collections: In order to secure reproductive data on *Sphaerium partumeium* in the natural habitat, a special series of weekly collections was begun early in March 1954. The pond had been dry since the previous June and the young clams produced in 1953 had rested over winter in the bottom mud. When early March rains filled the pond, the sphaeriids began to grow, and so the weekly collections were begun. They were continued until the pond was dry again at the end of July. An effort was made to take the same amount of material each time although careful quantitative measurement was unnecessary. In the process of hand-sorting collections in the laboratory, all animals were measured and the change in composition of the population was analyzed by breaking down each collection into size classes. Unfortunately, because of the nature of the collecting method employed, it was impossible to tell whether the young were born in the field or in sorting pans. However, they were of such size that they could easily live outside the parent, and so that point seems to be an unimportant one.

Table 3 shows the percentages of various size classes found in the collections, and the relative homogeneity of the population until the second week of June, when young first appeared in the collections. The fact that these young, whether born in the field

or collecting pans, had not grown could be seen easily by the appearance of the shells.

TABLE 3

Percentage Composition of Weekly Field Collections

(Data from two successive collections lumped)

Size Classes (in mm.)	Dates of Collection									
	3/12 3/19	3/26 4/2	4/9 4/16	4/23 4/30	5/7 5/14	5/21 5/27	6/4 6/11	6/18 6/25	7/2 7/9	7/16 7/23
1-2	86	31	7				15	46	58	56
2-3	14	69	57	7					6	18
3-4			33	69	6	3				1
4-5			2	36	39	13				
5-6				3	37	49	15	3		
6-7					18	33	45	19	9	8
7-8						2	22	19	19	15
8-9								8	6	2
9-10									2	

The mean birth length for field young was 1.6 mm. as compared with 1.44 mm. for laboratory material. Both of these lengths are well above the minimum size for successful growth. By the 13th week when young first appeared in field collections, the mean size of the adults was 6.2 by 5.1 mm. This is 1.7 mm. longer than the mean size of laboratory animals at the time of first birth. The field specimens produced larger young and were larger themselves because they all retained the young longer than did 73% of the laboratory adults. One explanation for this difference is to regard an environmental factor such as a change in water chemistry, change in water temperature, change in photoperiod, or mechanical disturbance as a birth stimulus. The other approach is to regard some environmental feature as an inhibiting factor, and birth as taking place only with its disappearance.

No attempt was made in this study to gather chemical data in

the field. The length of day by June 11 was 15 hours as compared with the 13-hour light period maintained in the laboratory during the winter months, at which time young were produced. It seems unlikely then that photoperiod has any bearing on the problem. In the course of the collecting period, large numbers of specimens brought in and sorted have given birth to young in the laboratory. An analysis of the sizes of offspring they produce reveals that they are no smaller than those born in the field. There is a very strong possibility, therefore, that they would have been born even if the parents had been left undisturbed in their natural habitat. Although specimens raised in the laboratory, and thus exposed to frequent brushing and handling, produced young earlier, the times of these births cannot be correlated with periods of handling. If disturbance retarded birth, the field young should be produced earlier. On the other hand, if it acted as a stimulus either it must be very wide-spread in the pond, or it might cause production of young by a few, and they in turn may stimulate other adults to do the same. Temperature change is another possibility. The week in which young animals began to appear in the field collections was marked by a sudden rise in water temperature. A high of 24° C. was reached on the day of the collection. This was 7 degrees higher than any previously recorded temperature and 16½ degrees higher than that of the previous week. Possibly a sudden extreme change may act as a stimulus or low temperatures may inhibit birth, and only when a certain threshold is reached will the young emerge. In this connection, the laboratory stock was kept at about 21° C. at all times except during July and August when temperatures were somewhat higher. Possibly 21° C. is close to the threshold for the species, and only at the 13th week was the field population exposed to it.

Summary

1. Self-fertilization in *Sphaerium* (*Musculium*) *partumeium* (Say) was demonstrated by the production of as many as 6 generations in isolation cultures.

2. Young may leave the parent through the excurrent siphon either by their effort or that of the parent.

3. There was a difference of 0.6 mm. in lengths of the largest and smallest, viable young.

4. The mean size of young produced was 1.44 by 1.12 mm.

5. The first young produced was significantly smaller than other offspring, and was produced between the 8th and 13th week of parental growth.

6. In a field population, young were not found until the 13th week, and the mean birth length was 1.6 mm.

7. It is suggested that some environmental factor is responsible for the delay in production of young by the field population.

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NOTES ON ODOSTOMIA IMPRESSA (SAY)

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Hopkins (1956) pointed out the ectoparasitic habits of *Odostomia impressa* (Say) and its relation to the oyster *Crassostrea virginica.* The abundance of this gastropod in a series of collections from oyster beds in the Beaufort, N. C., area provided an opportunity to follow the population for an 18 month period in 1955 and 1956. Observations were also made upon feeding and the egg masses of this species.

Feeding was observed under a dissecting microscope at the Duke Marine Laboratory in July 1956. *O. impressa* extended its proboscis between the shells of adult oysters, but its contact with mantle was hidden by the upper valve. In this position however, the activity of the buccal pump could be observed through the transparent walls of the proboscis. Small vibrations caused *O. impressa* to stop feeding and instantly withdraw its proboscis; even the vibration of a man's voice produced this characteristic withdrawal. This reaction is in contrast with the behavior of *O. impressa* described by Allen (1958), in which the prey (*Bittium varium*) could be moved about without causing the pyramidellid to withdraw its proboscis. *O. impressa* did not enter between oysters' valves voluntarily as will *Odostomia eulimoides* (Cole & Hancock, 1955), even when the top valve was removed. This behavior and its sensitivity to vibration serve to protect it from injury while feeding. When the top valves were removed from oysters and *O. impressa* were placed upon intact tissue, direct contact of the proboscis with the mantle was observed. In addition, they fed on isolated pieces of mantle tissue placed in a dish of seawater.

On the basis of its occurrence in collections from the Beaufort area, the gastropod *Bittium varium* probably is not an important

prey for *Odostomia impressa. Bittium varium* is most common on algae and in grass beds; its presence with oysters can be attributed to algal growths near or on the valves. On the other hand, *O. impressa* is primarily found on oyster beds. In a series of collections from oyster areas in Newport River, only twice was *B. varium* found without also finding *O. impressa*. In eighteen collections *O. impressa* was abundant, but *B. varium* was absent. In 16 collections in which both gastropods were collected, *O. impressa* outnumbered *B. varium* in 11, the proportion averaging more than 10:1. Of the remaining 5 collections in which *B. varium* outnumbered *O. impressa,* 3 were taken after low salinities had reduced the local population of *O. impressa*. The abundance of *Odostomia impressa* in oyster beds, apparently independent of the numbers of *Bittium varium,* is an indication of the greater importance of oysters as food for this species.

Odostomia impressa egg masses were collected on the following date:

1955—	May 7	14
	August 2	8
	September 13	2
1956—	May 30	3
	June 22	2
	September 6	4

Oviposition may occur throughout the summer, although there is a peak in the early part of the breeding season. These egg masses (fig. 1) are usually attached to an oyster shell. They are composed of a colorless mucus-like jelly which encloses each embryo within its own transparent cocoon, with 15 to 40 embryos contained in each mass. The sinistral embryonic shell marks them as the product of a pyramidellid, and the egg mass fits the general pyramidellid kind described by Thorson (1946). The general abundance of *O. impressa* and the absence of other gastropods at two collection sites indicate that these are the egg masses of *Odostomia impressa* Say. The egg capsules pictured by Perry and Schwengel (1955) as those of *O. impressa* must be the product of some other gastropod.

In order to follow the dynamics of the population, 16 collections containing a total of 1,747 specimens were analyzed for length composition; their length distributions are compared in figure 2. Each major collection is composed of several smaller

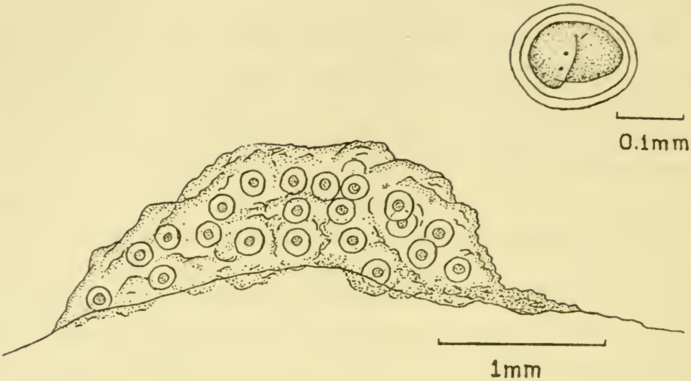

FIGURE 1: Egg mass of *Odostomia impressa* attached to an oyster shell. Inset shows a late embryo in its individual jelly cocoon.

collections made at 5 stations along Newport River.

Following the largest collection of egg masses in early May, the largest collections of young (about 1 mm.) were made in June and July, when they formed by far the most numerous class in the population. This component of the population could be followed in the collections throughout the year as the most numerous class, until the following summer when predation or natural death reduced its numbers and the next year-class appeared.

Starting in June and July when the population mean was 1.5 mm., the population quickly increased in length during the summer and fall, reaching a maximum in January of 4.75 mm. mean length. With continued growth, the most numerous class reached 5 or 6 mm. in spring collections. However, mortality of larger individuals offset any growth effects during this period, so that the mean hovered between 4 and 5 mm. until the appearance of the 1956 year-class. Its great numbers and small size caused the mean to fall rapidly to 1.4 mm. in late July. By this time, the large (5 and 6 mm.) individuals had dropped out of the population. Presumably, they were responsible for spawning most of the succeeding year-class. In most winter collections were small individuals (1 to 2 mm.) which had been produced by late ovoposition; numerically they were of little importance.

These observations indicate that *Odostomia impressa* normally

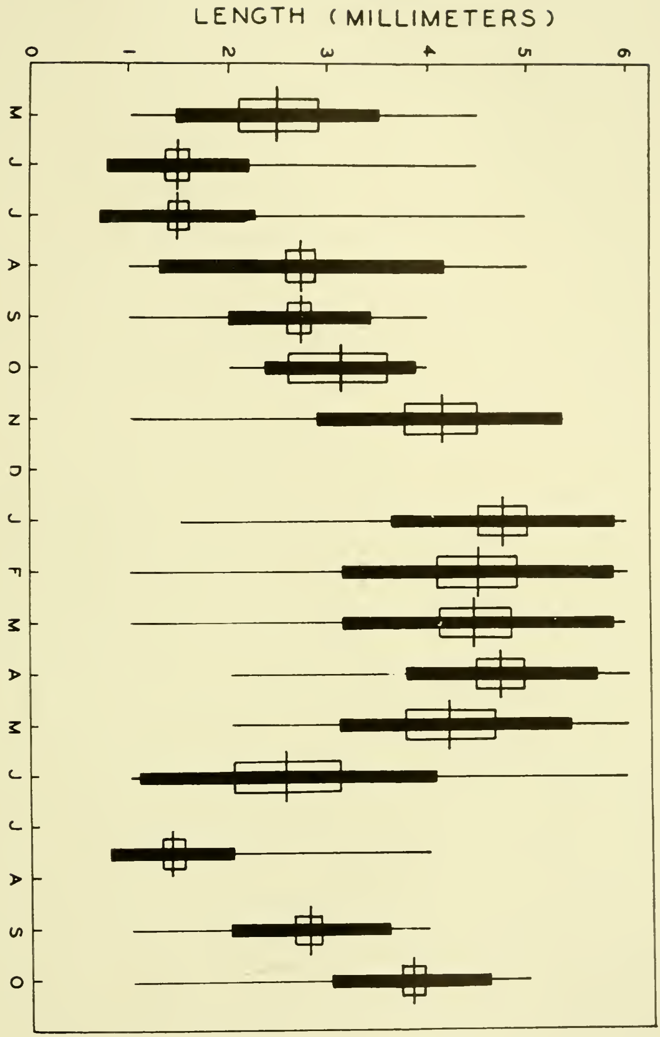

FIGURE 2: Length distribution for collections of *Odostomia impressa* from the Beaufort, N. C., area, May 1955 to October 1956. The letters refer to months. For each collection, the vertical line indicates the range; the solid rectangle, one standard deviation on each side of the mean; the hollow rectangle, twice the standard error on each side of the mean; and the crossbar, the mean.

lives but one year, being spawned the first summer, then spawning and dying the second.

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NOTES AND NEWS

American Malacological Union—The 25th annual meeting will be held on June 30 to July 3, 1959, on the Haverford College campus, Haverford, Pennsylvania. A visit to the Academy of Natural Sciences of Philadelphia is planned for Thursday afternoon, and a field trip to Cape May, New Jersey, for Friday. Bunny Baker, 11 Chelten Road, Havertown, Pa., will accept reservations for dormitories and meals.—B. B. B.

Habitat Change for Ferrissia.—F. C. Baker, in his study of "The Molluscan Fauna of the Big Vermilion River, Illinois" (*Ill. Biol. Monog.* Vol. 7, no. 2, 1922.), reported that specimens of the limpet *Ferrissia* were collected in the "Salt Fork, its usual habitat being inside of empty valves of the naiades" (p. 63). In a restudy of Baker's stations during the past two years, the writer has found that few valves of naiades are now found in the Salt Fork. *Ferrissia,* however, is even more abundant today than in 1918-20 and has taken over a new habitat. The great majority of specimens (identified by Paul F. Basch as *F. tarda*) were collected from the surfaces of beer cans which still retained smooth, shiny ones. These fresh, clean surfaces are somewhat comparable to the nacre of recently exposed mussel shells and serve the same purpose. As the surface of a beer can becomes encrusted with organic growth and attached material, and eventually as the rust breaks

through the surface, the can is no longer populated with as many limpets and probably those that are found under those conditions are survivals from the original population. New specimens settle in abundance on fresh cans. Fortunately for *Ferrissia,* though regrettable to some people, beer cans are becoming as common in some streams as empty mussel shells were in former years.—Ralph W. Dexter, Kent State University, Kent, Ohio.

An ecologic observation on *Succinea avara.*—In early April of this year (1958) a very large concentration of *Succinea avara* Say was brought to my attention by Dr. W. H. Irwin of Oklahoma State University. A small pond, located approximately one and one-half miles east of Stillwater, Payne County, just north of Highway 51, is surrounded by a gently-dipping, well-vegetated watershed. On investigating the area, the soil was found to be thoroughly saturated by the unusually heavy rains which were occurring at the time. The east slope of the pond's watershed supported luxuriant growths of *Nostoc* sp. from the water's edge to about 30 feet into the Bermuda grass which forms most of the cover around the pond. Several of the above named snail were associated with each of the firm, spherical colonies of *Nostoc.* In one square foot of surface area, I removed 31 specimens of *Succinea.* The count per square foot for the whole area, however, was probably higher than this. The snail shells cracked audibly as one walked over the area. As intimated above, this condition persisted for about 30 feet from the water's edge. Obviously, conditions were propitious for the growth of the *Nostoc* and the gastropods took advantage of the condition, utilizing the alga for food. This observation was made on April 9, 1958. Eleven weeks later (July 1, 1958), the soil had become dry and both the *Nostoc* and the snails had disappeared from the slopes of the pond. However, *Succinea* was abundant on the mud banks of the pond and was found crawling about on *Nelumbo lutea* and *Typha latifolia* in the pond.

Although *Succinea avara* is generally considered to be a terrestrial species, it is somewhat amphibious in Oklahoma. I have often found it on aquatic vegetation or pieces of dead vegetation in the water, as well as in truly terrestrial habitats. It nearly always will be found in moist situations where cyanophytous

algae or molds abound. In addition, the author kept *S. avara* and *S. grosvenori* in an aquarium, in which *Elodea* grew, for over a year. *Succinea avara* is a remarkably plastic species as regards its environmental requirements.—Branley A. Branson. Contribution no. 275 from the Department of Zoology and Research Foundation of Oklahoma State University, Stillwater.

Back issues of the Nautilus wanted.—The senior editor and his business manager wife have been making up sets of the Nautilus and taking inventory. Many back issues are short or completely lacking, although some are available in the incomplete sets. All our friends and subscribers are asked to keep on the watch for the back issues listed below. The Nautilus will be glad to buy them.

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8	1, 10	29	1, 11, 12	63	1
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10	3	31	1, 4	65	3
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If any pages are desired from issues that are no longer available I will typewrite them at stenographer's rates.

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PUBLICATIONS RECEIVED

Sea shells of tropical west America. Marine mollusks from Lower California to Colombia. By A. Myra Keen. 624 pp., many text-figs., and 10 colored plates + frontispiece and cover maps. Stanford University Press. $12.50. 1958.—To this very concise, but big "handbook," Dr. Keen has brought her wide knowledge of the marine mollusks of the eastern Pacific. Most of the larger and middle size, shell-bearing species from the continental shelf of the Panamic province are diagnosed briefly, distinguished in many dichotomous keys, and figured handily on the same or

adjacent pages. The known geographic ranges are given, along with notes on ecologic habitats, when these have been ascertained. Although modern, the nomenclature and the sizes of genera seem sensibly conservative. To cite a minor example, her rejection (p. 344) of Clench & Turner's identification of *Triton cynocephalum* appears commendable; to my amateur eyes, the latters' (1957, p. 243, fig. 2) nice copy of Lamarck's illustration looks much less like their adjacent fig. 1 (from Lower Calif.) than like their photograph (p. 199, fig. 2) of an apparently related *Cymatium* from the "Spanish Main." Dr. Keen makes no attempt to invent ephemeral, English names; this is especially welcome since the middle Americans speak Spanish, which, like French, readily converts "Latin" terms into vernaculars by slight changes in endings. She also does not bow to the proposed new "rules" for familial names. Who would want to replace Naticidae with Sigaretidae (1815), Terebridae with a name based on Subulata (1825), Turritellidae with one on Zariana (1850) or even Calyptraeidae with Crepidulidae (1822), although the return of such old friends as Auriculidae (1821), Pernidae (1815) and Doliidae (1825) might be welcome? The short glossary seems well chosen, and is amplified by many, clearly labeled figures in the places where they do the most good. Especially noteworthy is Dr. Keen's refusal to clutter up the text with repetitive citations (and acknowledgments), which are referred to conveniently in the bibliography (and "Sources"). Just think of how many times she might have copied the full title of Carpenter's "Mazatlan shells!" And, she evidently has studied them more carefully than some who have so quoted it.—H. B. B.

The marine mollusks of Grand Cayman Island, British West Indies. By R. Tucker Abbott. Monogr. Acad. Nat. Sci. Philadelphia, no. 11, 138 pp., 5 pls., 11 maps, 7 text-figs. $4.00. 1958.—This report, based on collections of Ruth and Alfred J. Ostheimer, 3rd, gives synonymies, descriptions, ecologic habitats and geographic ranges of 293 local species, and figures 60. New species are: *Emarginula ostheimerae, Coralliophila caribaea* (east Mexico), *Latirus* (*Polygona*) *virginensis* (Virgin Is.), *Ithycythara parkeri, Turbonilla* (*Pyrgiscus*) *alfredi, Strombiformis auricincta, Cosa caribaea* and *Transennella gerrardi. Murex* (*Phyllonotus*)

margaritensis is a new name for *M. imperialis* Swainson (Margarita I.).—B. B. B.

A historical review of the mollusks of Linnaeus. Part. 6. The genus *Trochus* of the class Gastropoda. By Henry Dodge. Bull. Amer. Mus. Nat. Hist. *116*:157-223. 1956.—This discusses in detail the identifications and present usages of the 26 trivial terms used by Linné in the genus.—H. B. B.

Endodontidos Neotropicales, I. II. By M. I. Hylton Scott. Neotropica *3*:7-16, 3 figs.; 79-87, figs. 4 & 5. 1957.—This discusses *Radiodiscus*. In an artificial key, 19 S. A. species are recognized, of which 6 are described as new. Unfortunately, the soft parts are not described. The figures of some of the smaller shells look like the genus *Punctum*, and the only known anatomy of a S. A. species, *R.* (*Radioconus*) *bactricola* (not "*-us*") is very different from that of the typical subgenus.—H. B. B.

The Brazilian species of "Drepanotrema." IV, *"D. cimex"* (Moricand, 1837). V, *"D. nordestense"* (Lucena, 1953). VI, *"D. kermatoides"* (Orbigny, 1835). By W. Lobato Paraense & Newton Deslandes. Rev. Brasil. Biol. *18*:187-192, 4 figs.; 275-281, 8 figs.; 293-299, 6 figs. 1958.—Excellent figures of the shells and of dissections are included. Because of its aberrant shell, *D. nordestense* was described in *Tropicorbis*.—H. B. B.

Type specimens of marine Mollusca described by P. P. Carpenter from the west coast (San Diego to British Columbia). By Katherine van Winkle Palmer. Memoir 76, Geol. Soc. of Amer., vi + 376 pp., 35 pls., 1958.—This very complete and carefully documented account of P. P. Carpenter's west coast types will serve as a valuable tool for those interested in the mollusks of the eastern Pacific, north of San Diego. 190 types are illustrated. Authentic whereabouts of the types have been determined; type localities, evaluation of names with synonymies, and historical background have been included. There is also an interesting account of Carpenter's scientific career. A tremendous amount of labor has gone into bringing the nomenclature up-to-date. Although not specifically germane to the

type problem at hand, it will save many hours for future workers. One of the drawbacks of "monographing" each species is that information already published is sometimes overlooked. For instance, *Liotia cookeana* Dall, 1918, is a *Cyclostrema* and not a synonym of *Liotia fenestrata* Carpenter, 1864 (see Johnsonia, vol. 2, no. 27, p. 199). An excellent bibliography and index are included.—R. Tucker Abbott

Estudio morfologico y taxonomico de los ampullaridos de la Republica Argentina. By Maria I. H. Scott. Rev. Mus. Arg. Cienc. Nat., Zool. *3*: 233-333, pls. 1-23. 1957.— This detailed, anatomic and systematic study of the Argentine species of *Ampullaria* (*Pomacea* Perry), *Marisa, Felipponea* and *Asolene* is well illustrated. Some embryologic data are included also. The author concludes that the uniformity of the soft parts inside each genus gives few specific characters, except in *Ampullaria canaliculata,* which like *A. insularum* is often hermaphroditic. The most usable structure for generic distinction is the large sheath ("vaina") around the base of the vermiform verge proper ("penis"). The vergic complex differs markedly from the Old World *Pachylabra* (*Pila* Roeding). Dra. Scott's reasons for the use of *Ampullaria* as an American genus seem very sensible, even if not nomenclaturally legal. But, on similar grounds, *Ceratodes* Guilding would be much preferable to Gray's very dubious *Marisa.*— H. B. B.